THE MARINE REVIEW

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Freighter for the A. H. Bull Steamship Company.

THE steel freight steamship being built by the Newport News Ship Building & Dry Dock Co. for the A. H. Bull Steamship Co. of New York is distinguished in the fact that she is the first freighter, intended for foreign trade, built in the United States during the past 10 years. Her principal use will doubtless be in coast service or until favorable opportunities offer in the foreign trade. The new steamer has the following principal dimensions:

Length over all	329 ft.
Length from aft side of stem to fore side of rudder post	317 ft.
Beam molded	46 ft.
Depth molded	24 ft. 3 in.
Load draft	20 ft.
Dead weight carried on above draught, about	4,600 tons.

As indicated on the accompanying general arrangement plan the vessel has a single deck, a raised forecastle, long bridge, short full poop and is schooner rigged with two pole masts. There are two separate steel deck houses on the bridge deck, a steel pilot house on top of the for'd deck house and a flying bridge at level of top of the pilot house. The machinery is located amidships, the two main boilers arranged with an athwartship stokehold for'd and a screen bulkhead dividing the boiler and engine rooms. Side bunkers are fitted abreast the boilers and at the sides of the engine room, the bunkers being filled by a coal chute located between the boiler and engine casings, with its hatch at the level of the top of the deck house. Additional coaling facilities are provided through small hatches in the bridge and upper decks directly over the boiler room bunkers.

Five Watertight Bulkheads.

The vessel is divided into compartments by five watertight bulkheads all extending to upper deck. These are located at the fore peak, in the middle of the forward hold, for'd of the boiler room, aft of the engine room, and at the after peak respectively. The after hold is divided into compartments by a portable wooden bulkhead, and a similar bulkhead is located near the after end of No. 2 hold to provide a reserve bunker forward of the boiler room. The cargo holds are further subdivided by a centerline bulkhead extending from the tank top to upper deck. This bulkhead is of steel between the hatches and in way of hatches is of wood made portable. There is one large hatch to each of the cargo holds, all hatches having coamings 3 ft. 6 in. high. The space under the bridge deck, with the exception of that devoted to machinery casings is used entirely for cargo, as is also the space under the poop. Portable wooden shifting boards are fitted at the centerline under the bridge deck, extending from the boiler casing to the for'd end. The total cargo space is 244,000 cu. ft. for bales and 263,000 cu. ft. for grain.

Accommodations for the officers and crew are provided in the two deck houses and under the forecastle deck. The forward deck house contains staterooms for the captain and deck officers, a bath room, officers' mess, pantry and store room. The after deck house contains staterooms for the engineers' and cooks, a bath room, mess room and pantry. Under the forecastle two staterooms are provided for quartermasters, carpenter and boatswain; also quarters for six seamen and 10 firemen. The galley is located in a separate steel enclosure forward of the boiler casing. The pilot house is provided with a separate chart room which is also arranged for use as a stateroom. In the captain's quarters the finish is oak, in the other quarters it is cypress.

Detail of Construction.

The general type of construction is indicated on the accompanying plan of midship section. The vessel is being built under Lloyds Spar Deck Rules with one deck and a tier of wide spaced hold beams with a wide stringer fitted on the latter. There is a double bottom throughout with solid floors on every frame and two intercostal longitudinals on each side of the vertical keel. Double frames and additional longitudinals are fitted at the forward end. This construction of double bottom was adopted on account of the liability of the vessel being aground at times when loading. Between the peak bulkheads deep channel framing is used, and the ordinary angle and reverse frame construction in the peaks. In way of the bridge the frames are cut at the upper deck and angle bar frames used between the upper and bridge decks. The upper and bridge decks are complete steel decks with channel beams

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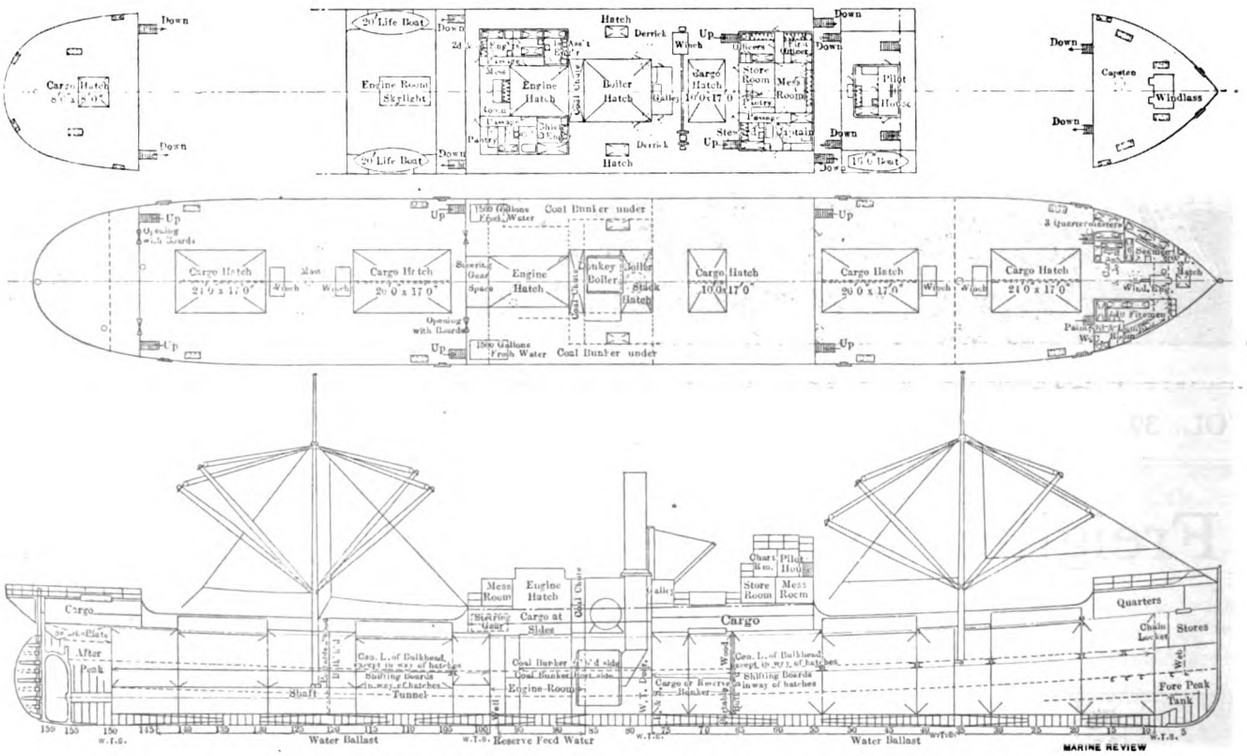
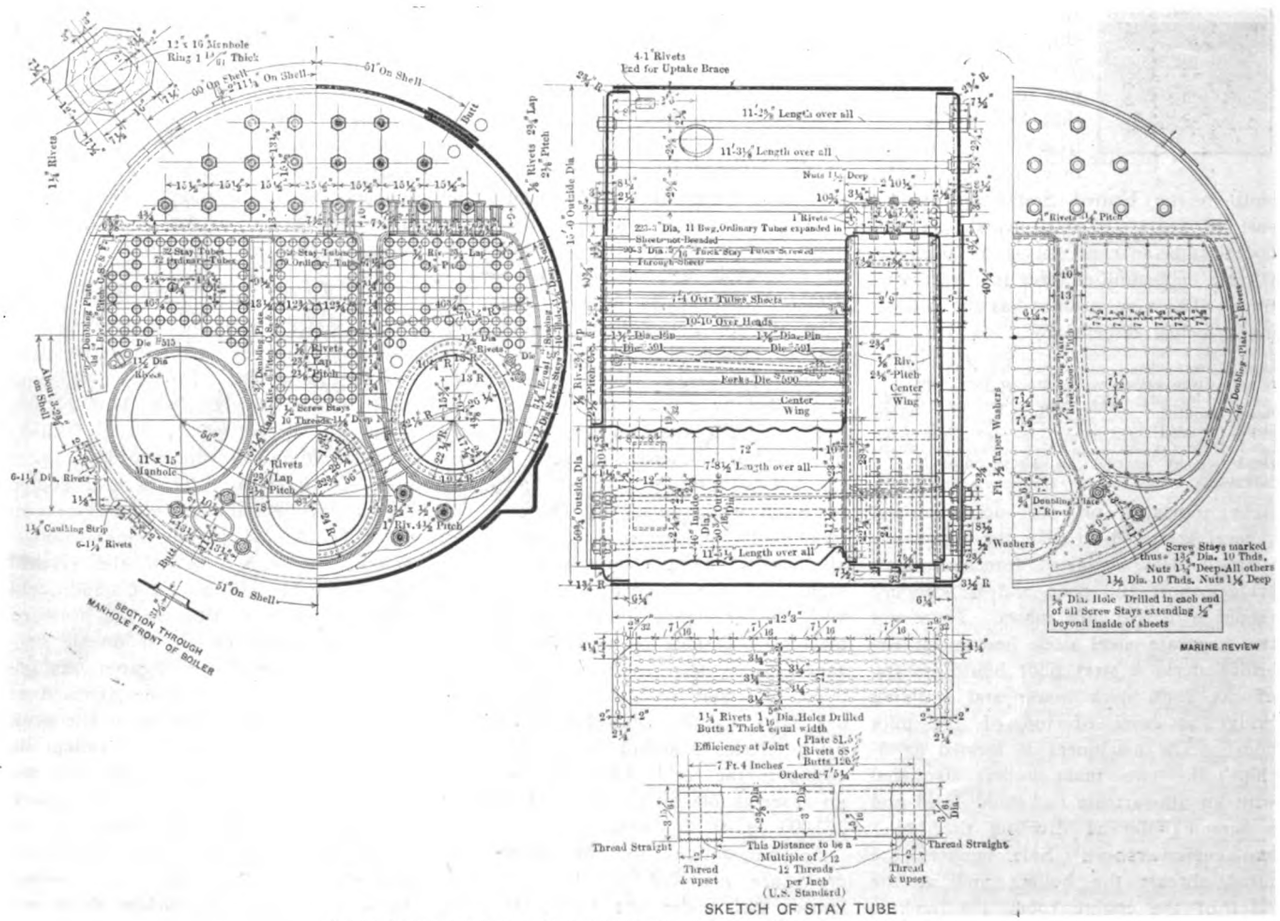


PLAN OF STEAMER BUILDING FOR A. H. BULL & CO., SHOWING GENERAL ARRANGEMENT.


12'x16" Manhole Ring 1 1/16" Thick
51" On Shell
60" On Shell
Butt
Stay Tubes
Drilling Tube
Screw Stays
Rivets
Lap
Pitch
11"x15" Manhole
Caulking Strip
6-1 1/4" Rivets
SECTION THROUGH MANHOLE FRONT OF BOILER
4-1" Rivets Ext'd for Uptake Brace
11'-2 5/8" Length over all
11'-3 1/8" Length over all
Nuts 1 1/16" Deep
1" Rivets
Over Tubes Sheets
Over Heads
Forks-Dia. 3.500
Center Wing
7'8 1/8" Length over all
11'-3 1/8" Length over all
Taper Washers
Screw Stays marked thus+ 1 3/8" Dia. 10 Thds, Nuts 1 1/16" Deep. All others 1 3/8" Dia. 10 Thds. Nuts 1 1/16" Deep
3/4" Dia. Hole Drilled in each end of all Screw Stays extending 1/2" beyond inside of sheets
1 1/8" Rivets 1 5/16" Dia. Holes Drilled Butts 1" Thick equal width
Efficiency at Joint (Plate 81.5 Rivets 88 Butts 126)
7 Ft. 4 Inches
Ordered 7'5 1/4"
Thread Straight
This Distance to be a Multiple of 1/12
12 Threads per Inch (U.S. Standard)
Thread & upset
SKETCH OF STAY TUBE
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MAIN BOILER OF THE STEAMER BUILDING FOR A. H. BULL & CO.

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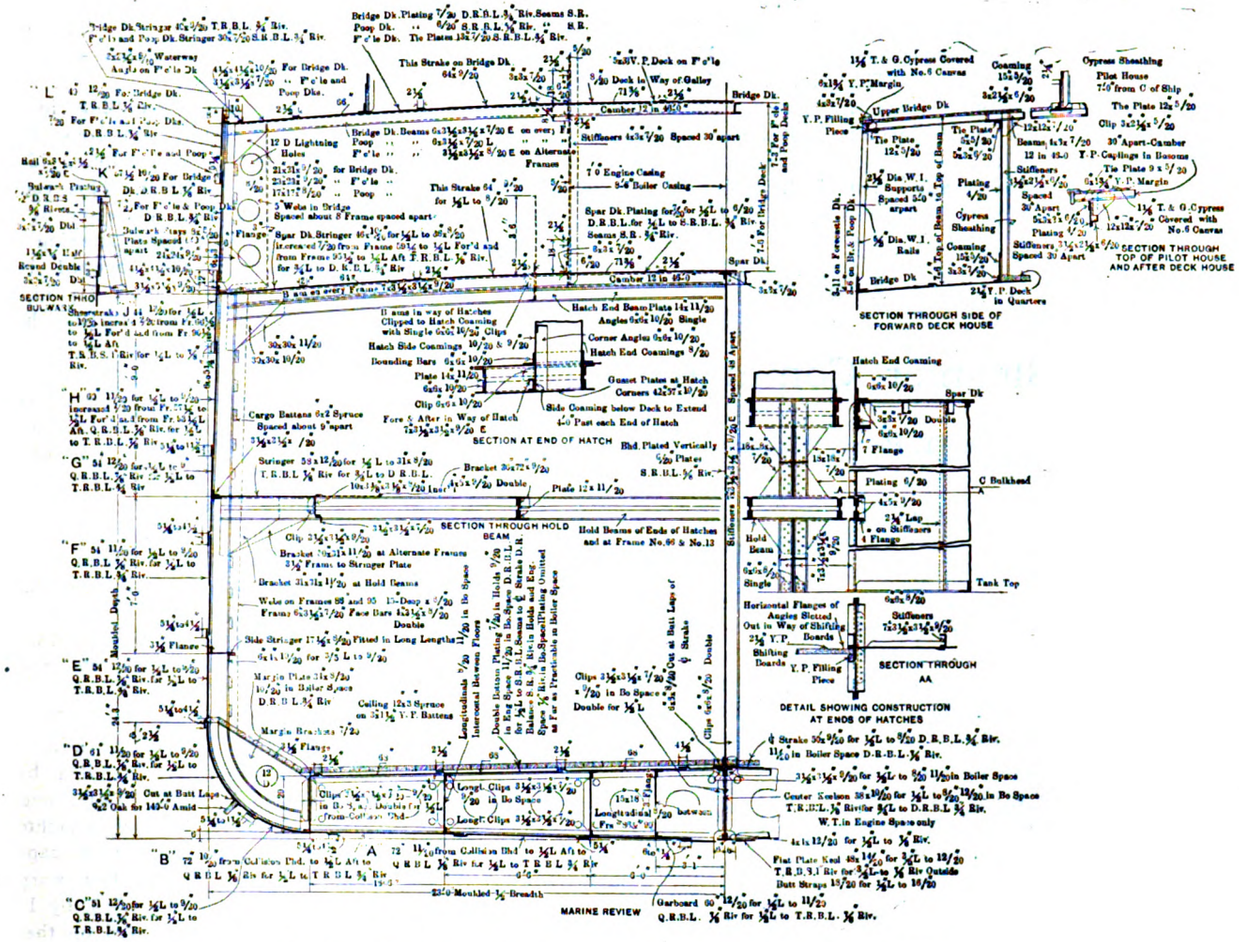
SECTION AT END OF HATCH
SECTION THROUGH HOLD BEAM
SECTION THROUGH SIDE OF FORWARD DECK HOUSE
SECTION THROUGH TOP OF PILOT HOUSE AND AFTER DECK HOUSE
SECTION THROUGH AA
DETAIL SHOWING CONSTRUCTION AT ENDS OF HATCHES
MARINE REVIEW

MIDSHIP SECTION OF THE STEAMER BUILDING FOR A. H. BULL & CO.

on every frame. At hatch ends the deck beams are built up of plate and angles. Hold beams are built up of plate with double angles top and bottom.

The centerline bulkhead is stiffened by vertical channels spaced 48 in. centers. Machinery casings of steel extend to the top of the bridge deck house.

Wood ceiling is fitted on the tank top and bilge brackets, and cargo battens on the side frames throughout the cargo holds.

Cargo Handling Gear.

The cargo handling gear consists of two booms on each side of the fore and main masts and two derrick posts on the bridge deck with one boom on each. The booms on the masts are 40 ft. to 46 ft. long and those on the derrick posts 32 ft. long. The latter are arranged so that they span the coal hatches as well as the bridge deck cargo hatch. For operating the main cargo booms four Lidgerwood double 8¼ in. x 10 in. winches are provided each winch having two drums and two gypsey heads so that two cargo booms can be operated by one winch. There is also one Lidgerwood single 6¼ in. x 10 in. winch with extension shaft, located on the bridge deck, for use with derrick post booms.

Steam steering gear is provided, a steam engine of the Lidgerwood Mfg. Co.'s make being located at the after end of the engine casing on the upper deck level. There is a Hyde windlass and a steam capstan located on the forecastle deck with the windlass engine on the deck below, from which both are driven. Baldt type stockless anchors are fitted. The vessel is heated throughout by steam.

The Machinery.

The main propelling engine is triple expansion with cylinders 22 in., 37 in. and 60 in. x 42 in. stroke. Piston valves are fitted to the high and intermediate cylinders and a double ported slide valve to the low pressure. Separate liners are fitted in the high pressure cylinder and for the piston valves and a false face for the slide valve. All valves are operated by Stephenson double bar link motion. Steam reversing gear of the direct type is provided. The bedplate and housings are cast iron of box section. The crank shaft is built up in three interchangeable sections. A horse-shoe type of thrust bearing is fitted. The propeller wheel is a solid cast Iron one with four blades. The main air pump is of the Edwards patent type driven from the low pressure crosshead. Two main feed pumps, two bilge pumps, and an evaporator feed pump are also driven from the air pump beam. The surface condenser is separate from the main engine framing and has a cylindrical cast iron shell with 1,900 sq. ft. of cooling surface. A centrifugal pump driven by a single vertical engine is used for circulating water through the condenser. All independent steam pumps are of the Blake type and consist of a ballast pump 10 in. x 10 in. x 12 in. duplex, donkey pump 9 in. x 5¼ in. x 10 in. vertical duplex, and donkey boiler feed 4½ in. x 2¾ in. x 4 in. special duplex. There is also a 12 ton Reilley evaporator.

There are two main boilers each 15 ft. diameter x 10 ft. 10 in. long built

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for 180 lbs. working steam pressure. Each boiler has three 46-in. corrugated furnaces with separate combustion chambers, and 313 3-in. tubes. The total heating surface of both boilers is 4,400 sq. ft. and total grate surface 149.5 sq. ft.

For supplying steam to winches and for general harbor use there is a donkey boiler of the Scotch type located on the upper deck level above the main boilers. This boiler is 9 ft. diameter x 10 ft. 5½ in. long, has one 52-in. corrugated furnace, 108 3-in. tubes and is built for a working pressure of 90 lbs.

The hull and machinery are being built under Lloyds special survey to class *A-1.

The Steamer Commonwealth.*

By Warren T. Berry, Esq., and J. Howland Gardner.

THE COMMONwealth was built for service between New York and Fall River, a run of 180 statute miles, making one stop of about half an hour at Newport. The maximum designed speed is 22 statute miles per hour, although the established schedule requires a speed of only 18 statute miles, and with fair tide and wind 16 statute miles are all that are necessary. A speed of 20 or 22 miles is often required to minimize delays caused by head tides, high winds, delays at terminals and fog detention.

Inquiry was made as to the advisability of installing the Parsons type of turbine, but the economical results appeared to be rather experimental for speeds varying between 16 and 22 miles per hour.

Experience with propeller and side-wheel steamers, in this particular service, demonstrates that very much greater overhang of guard can be fitted to the side-wheel boat. On the Commonwealth 19 ft. 8 in. overhang, each side of hull, was necessary to provide for the spacious saloons and staterooms demanded by the traveling public. This extreme breadth of guard is in addition a very efficient safeguard against serious damage to the hull in case of collision.

The compound inclined engine with feathering wheels, as adopted, combines the ability to stop and back very quickly, utilizes only lower hold space, which is of very little value for freight or passenger accommodation, and avoids the excessive vibration common to screw propellers in shallow draught vessels.

The contract for building this steamer was made by the New England Navigation Co. with the Quintard Iron Works Co., on Oct. 12, 1906, the specified time of delivery July 1, 1908. The hull was launched at the yards of The William Cramp & Sons Ship & Engine Building Co., Oct. 9, 1907, and the work of installing machinery and joiner work immediately commenced. The steamer was finally delivered, ready for service, with furniture and outfit complete, June 23, 1908.

General dimensions are as follows:

Length over all, 455 ft. 2 in.

Length between perpendiculars, 437 ft. 11 in.

Beam of hull molded, 55 ft.

Beam over guards, 94 ft. 7 in.

Molded depth lowest point of sheer, 22 ft.

Table of Weights.

Hull, ship carpenter work and steel construction, 2,210 gross tons.

Joiner work, 835 gross tons.

Steam engineering, 1,760 gross tons.

Hull engineering, 240 gross tons.

Coal, 150 gross tons.

Water, 40 gross tons.

Equipment, furniture and outfit, 175 gross tons.

Total, 5,410 gross tons.

Displacement light (13 ft. draught salt water) 5,410 gross tons.

Displacement loaded (15 ft. draught salt water) 6,410 gross tons.

The hull is built on the bracket plate and longitudinal system of the general scantling shown on midship section. Seven water-tight bulkheads extend to the main deck without doors or other openings, dividing the hull into eight water-tight compartments above the double bottom. The double bottom extends for a length of 335 ft. and the margin plate is 5 ft. above the base line. This double bottom is divided into 46 water-tight compartments.

To obtain quick handling in the harbors of Newport and New York, a rudder 14 ft. 8 in. long, 12 ft. 6 in. deep, is installed. This rudder is operated by 26-in. diameter by 16-in. stroke Sickles type steering engine, located in the forward hold, connected by wire cables 1⅝ in. diameter to a circular steering head. This steering head is fastened to rudder stock at center and nigger-head at aft end of rudder, in order to distribute the stresses on the rudder and do away with the use of aft quarter blocks.

The stock is utilized as a steadiment and for connection to a hand-auxiliary gear of the diamond screw type located on the saloon deck. A mechanical telegraph is fitted for communication from the pilot-house with direct reply from the rudder stock.

Two stockless anchors of 6,500 lbs. each, with 180 fathoms of 2-in. stud link chain cable, are handled by a two-cylinder, 14-in. by 14-in. anchor windlass with a capstan attachment on saloon deck and two capstan heads on main deck. For warping steamer into dock two 12-in. by 14-in. steam capstans are located on the aft quarters.

Propelling Machinery.

The propelling machinery, designed for a maximum indicated horsepower of 10,000, is composed of a double compound, inclined, reciprocating engine with two high-pressure cylinders 50 in. diameter and two low-pressure cylinders 96 in. diameter, with a common piston stroke of 114 in. connected to two pairs of cranks set at right angles, shrunk on hollow forged steel shafts. The shaft is in three sections: two outboard or wheel shafts and one center shaft, all 27 in. diameter at the main journals and 30 in. diameter at the gunwale bearings. The crank pins are 22 in. diameter shrunk in cranks on outboard shafts, but arranged with loose brass chocks in the inboard cranks to provide for any change of alignment.

All cylinders are fitted with double poppet valves, Sickles adjustable cut-off on the high-pressure cylinders, and Stevens fixed cut-off on the low-pressure cylinders, all operated with Stephenson links controlled by a 20-in. by 24-in. steam reversing engine. Two surface condensers of cylindrical type, each containing 8,000 sq.

*Paper read at annual meeting Society of Naval Architects and Marine Engineers, New York.

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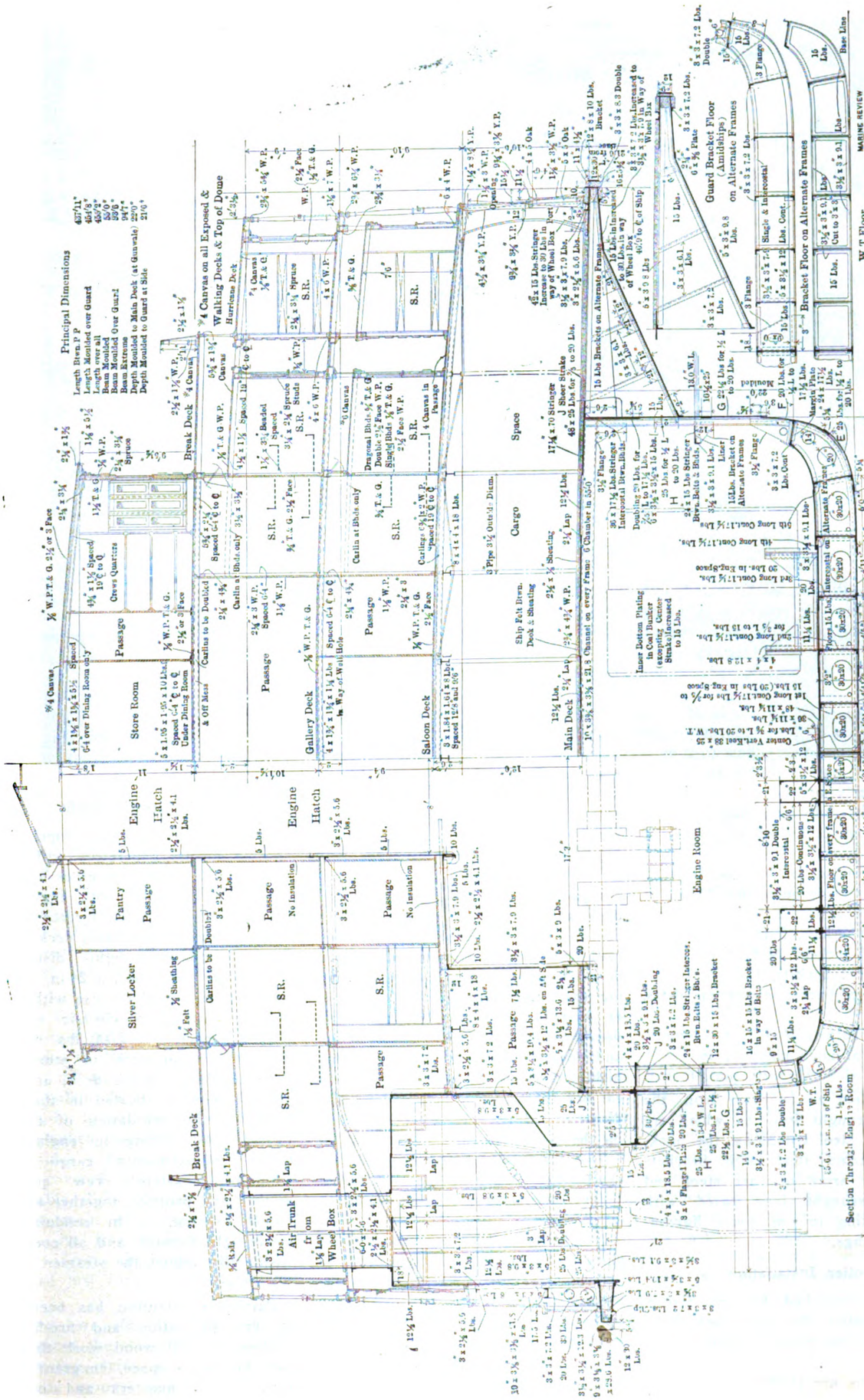

MIDSHIP SECTION OF STEAMER COMMONWEALTH.

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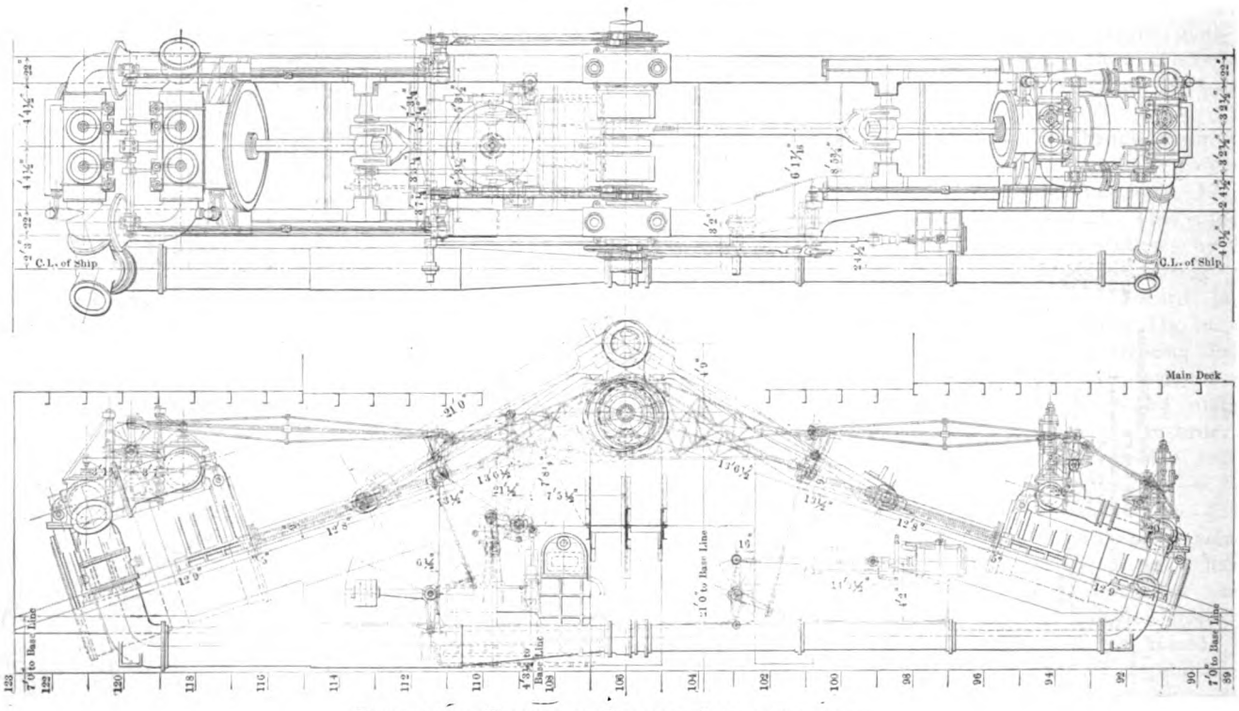

DIAGRAM OF ENGINE OF STEAMER COMMONWEALTH.

ft. cooling surface, are located outboard of the low-pressure cylinders, with suction pipes to two vertical air pumps 5 ft. diameter by 30-in. stroke connected to the low-pressure crossheads.

The engine frame is built of steel plates and angles in the form of box girders, so arranged that the main bearings are entirely within the frame.

The wheels are of the feathering type, of the following dimensions:

Diameter at center of trunnions, 26 ft. 9 in.

Diameter outside of buckets, 31 ft.

Diameter outside outer rim, 33 ft.

Number of arms, 12.

Width of buckets, 5 ft.

Length of buckets, 14 ft. 6 in.

Thickness of buckets, 1 in.

Thickness of bucket reinforcing plates, ⅞ in.

Curve of buckets, 9 ft. 6 in. radius.

Diameter of main pins, 8¼ in.

Diameter of rocker arm pins, 6 in.

The centers are of cast iron, the arms of wrought iron, to which are bolted cast steel trunnions, the buckets of marine steel with brackets and rocker arms of cast steel and pins of wrought iron cased with brass working in one piece lignum-vitae bushings.

Boiler Installation.

Steam is supplied by ten Scotch boilers located five on each side, with center fire-room extending fore and aft.

The boilers are 15 ft. 6 in. diameter by 13 ft. 6 in. long, each having three Morrison furnaces, 50 in. inside diameter, with a total grate surface of 937 sq. ft. and a total heating surface of 29,340 sq. ft.

Forced draft is supplied to closed ash pits by four blowers; two of these blowers are 7 ft. in diameter by 32-in. face, driven by direct-connected engines, 7 in. diameter by 10½-in. stroke, and two blowers 8 ft. in diameter by 38-in. face, driven by direct-connected engines, 10 in. diameter by 12-in. stroke. The discharge from two blowers located in the forward compartment is led over the main deck at forward fire-room bulkhead, and the suction ducts for aft blowers lead from engine room over the main deck at aft fire-room bulkhead, leaving the bulkheads water-tight. Blower ducts are so arranged that they ventilate engine room, boiler room and forward cabins as well as furnishing air for forced draft. A vertical fire tube donkey boiler, 7 ft. 2 in. diameter, 12 ft. 5 in. high, is located on the main deck.

The following pumps complete the engine installation:

Four centrifugal circulating pumps, 12-in. suctions.

Two boiler feed pumps, outside packed plunger, duplex 14 in. x 9 in. x 18 in.

Two fire and sanitary pumps, also connected to boiler feed lines. All brass water ends, duplex 18½ in. x 12 in. x 12 in.

One sprinkler pump. All brass water ends, duplex 16 in. x 12 in. x 12 in.

One bilge pump, duplex 10 in. x 8½ in. x 12 in.

One fresh water sanitary pump, duplex 6 in. x 6 in. x 12 in.

One donkey feed pump, single 6 in. x 3¾ in. x 7 in.

Two injectors for boiler feed.

Two 8-in. diameter by 15-in. stroke bilge pumps operated from main engine.

The Electric Outfit.

The electric outfit is comprised of two 75 K. W. generators with 10½-in. by 18-in. by 8-in. engines and one 50 K. W. generator with engine 9½ in. by 15 in. by 6 in., located in the engine room on the main deck, about 3,000 incandescent lights distributed throughout the vessel, a 24-in. searchlight on top of pilot-house with pilot-house control, an electric elevator with a capacity of 2,000 lbs. running from the main deck to store-room and kitchen on dome deck, and two electric blowers located in the after hold for the ventilation of the aft cabins. All wiring in engine and boiler compartments, cargo space, emigrant quarters, crew quarters, kitchen and pantries, together with all outside wiring, is in conduit with steam-tight fixtures, and all concealed wiring throughout the steamer is also run in conduit.

Particular attention has been paid to fire protection and fire-fighting appliances. All wood work throughout the cargo space, emigrant quarters, crew's quarters and on the

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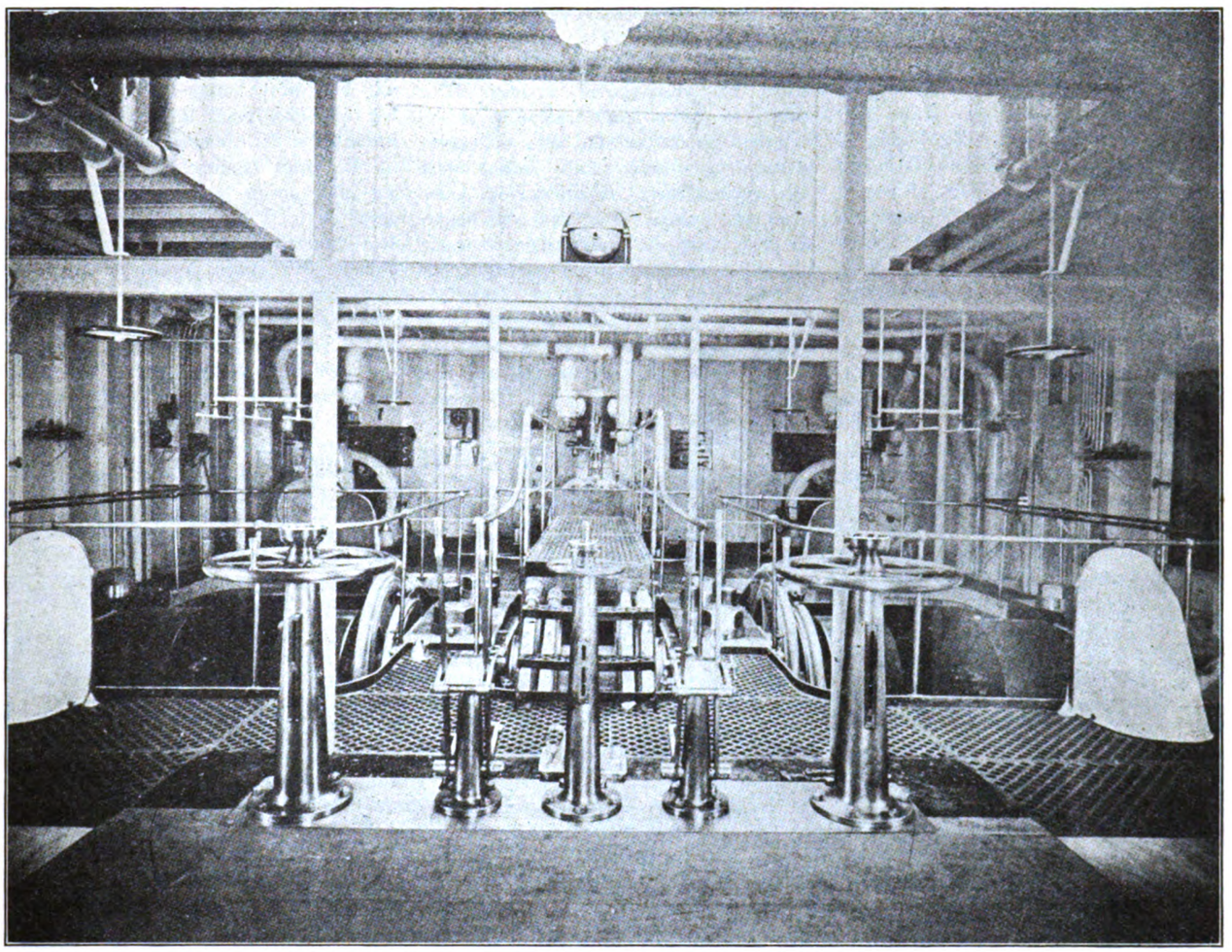

STEAMER COMMONWEALTH ENGINE ROOM.

main deck, and kitchen on the dome deck, is covered with galvanized iron, fastened directly to the wood. Steel decks are fitted over boiler compartment, coal bunkers and engine compartment. The engine room and boiler room ventilators and enclosures are of steel extending through top of dome.

Two fire bulkheads are provided, extending from the main deck through all decks to the dome, dividing the vessel into three fire compartments. These bulkheads are of double thickness 7/8-in. tongue and grooved wood, cross-planked diagonally and lined on both sides with Sackett plaster wall board covered with galvanized iron.

Suitable sliding doors are provided in the main corridors and freight space. An iron bulkhead extending entirely across the upper deck house, is fitted just forward of the kitchen range.

There are 65 hydrants located throughout the steamer, connected by copper fire mains with the fire and wrecking pumps, a 50-ft. length of hose is coupled to each hydrant and the location is such that all portions of the steamer are protected. Portable hose are also carried by both engine and deck departments, and 37 fire extinguishers are located in convenient places.

Fire Fighting Equipment.

In addition to this an independent sprinkler is provided, with 1,800 automatic Grinnell heads, distributed throughout the interior of the steamer, staterooms, and lockers, not exceeding 8 ft. from center to center in any place. This system is divided into 30 circuits, each with a 4-in. diameter main from a manifold located in the engine room on the main deck. To this manifold the main discharge from a 16-in. by 12-in. x 12-in. duplex sprinkler pump is connected. This pump at all times maintains a pressure at the manifold of 100 lbs. per sq. in. and is fitted with a governor to maintain this pressure in case of the opening of any of the circuits and sprinklers, and is also fitted with a throttle by-pass which can be operated from the main engine room.

Supplementary to this system is a thermostat system with mercury thermostats located not over 12 ft. centers with all wires run in conduit, and divided into circuits corresponding with the sprinkler circuits. This system terminates at two annunciators, one in the main saloon and one in the engine room indicating the circuit number. The opening of a valve of corresponding number on the sprinkler system manifold supplies water to the sprinklers at the fire.

In addition to the two main annunciators on the thermostat system, small annunciators are located throughout the saloons to determine the location of a fire within a range of a few staterooms. All the annunciator drops, besides showing the circuit number, indicate the location on the steamer and ring 8-in. alarm bells located in the crew's qarters, engine room and saloons. This system deviates to some extent from the systems in use on land. The

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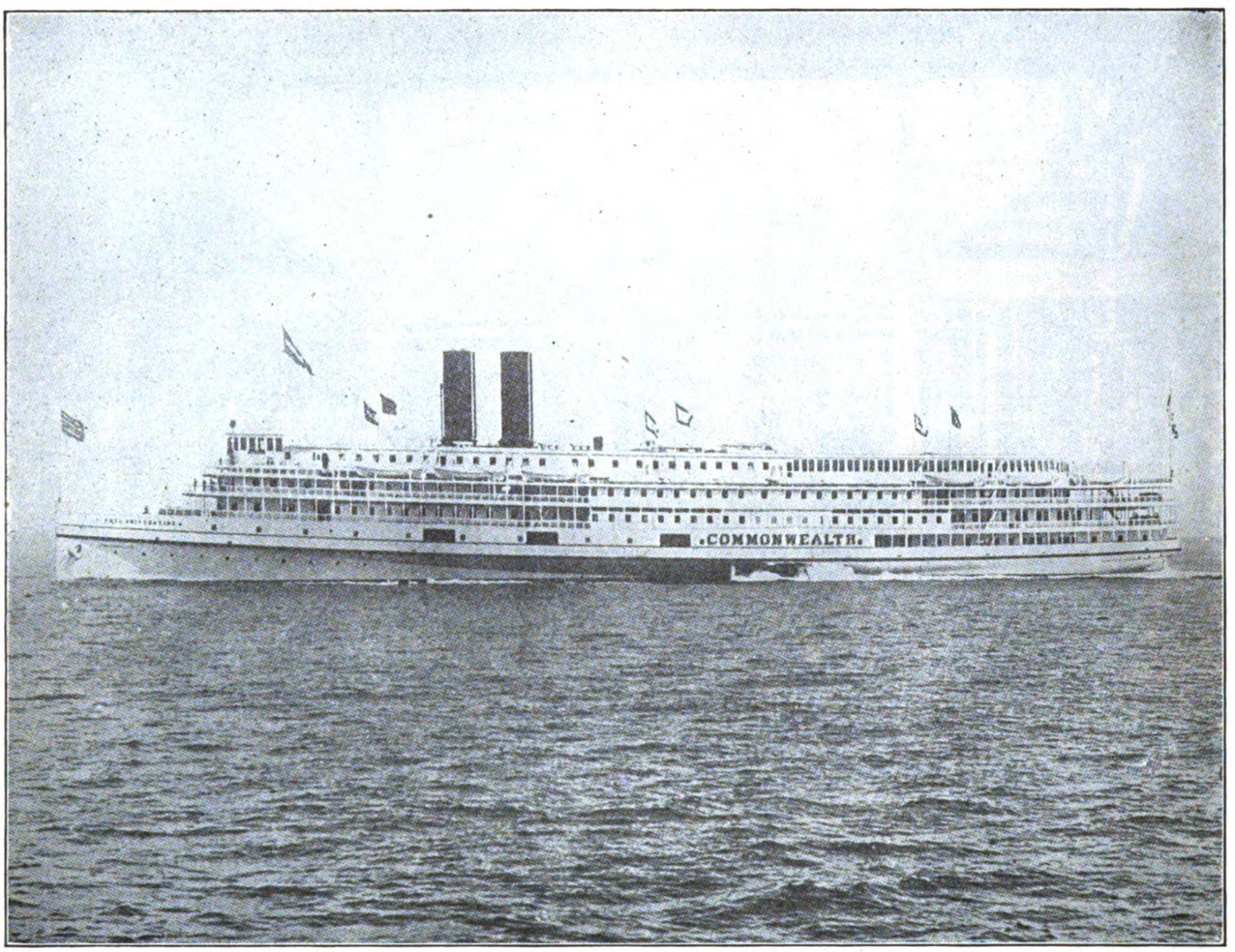

STEAMER COMMONWEALTH, OUTBOARD VIEW.

wet-pipe system, where all the pipes are filled with water under pressure, was impossible because of the great weight and danger of freezing. The dry-pipe system with pipes filled with air under pressure which, when released, operates an automatic valve admitting water to the system, was not used because of the possibility of flooding a section of the ship where the pipes might be damaged in case of collision.

A watchman's time detector is connected with 38 recording stations so located that in order to make a proper record, the watchman must pass through every section of the ship.

Wrecking Pumps.

An 8-in. wrecking suction pipe is run fore and aft under the main deck. This is connected by 8-in. valves and suction lines to each compartment above the double bottom. The valves are so located in the compartments that they can be operated from the main deck. This system is connected to the two 18½-in. by 12-in. by 12-in. pumps on the main deck. The 10-in. by 8½-in. by 12-in. bilge pump, located in the engine compartment, has an independent suction line to each compartment above the double bottom and a connection to each of the 46 water-tight compartments in the double bottom. The four 12-in. circulating pumps are each fitted with 12-in. bilge suctions.

Twelve metallic lifeboats, ten 26 ft. by 7 ft. by 2 ft. 9 in. deep, and two 26 ft. by 6 ft. 8 in. by 2 ft. 9 in. deep; 12 life rafts, six 20 ft. by 6 ft. 8 in., and six 18 ft. by 6 ft. 8 in. by 2 ft. 3 in. deep; 2,250 block cork life preservers distributed throughout the staterooms, crew's quarters and saloons, and a Lyle gun complete the life saving equipment.

A standard long distance telephone is located in every stateroom and at various places throughout the saloons and crew's quarters, all inter-communicating through a switchboard. Independent telephones are fitted between the pilot house and engine room, and pilot house and wireless telegraph room.

The location of the passenger toilet rooms between engine and boiler enclosures, entirely away from ventilation through outside windows, as usually installed, utilizing a portion of the steamer that is undesirable for staterooms, is a departure which the result in use has justified. Large ventilators extend from the toilet rooms to the upper deck, one ventilator immediately back of the kitchen range and the other against the iron engine room enclosure. The heat from the range and engine room enclosure creates a draft through these ventilators affording perfect ventilation. In addition suction pipes are connected to each urinal and toilet bowl extending to siphon hoods on the upper deck.

The officers' and crew's quarters are located mainly on the dome deck forward of the dining room and kitchen, though the deck hands and firemen are located below the main deck forward.

On the dome deck is located the officers' mess room seating 46, 30 officers' staterooms, with three water closets and two shower bathrooms for crew.

The kitchen and pantries are loca-

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ted between and around the boiler and engine enclosures on the dome deck. All wood work in the kitchen is lined entirely with galvanized iron and the floors covered with sheet lead and tile set in Sarco cement. The kitchen is fitted with a sectional range 21 ft. 6 in. long, with six ovens and six fires, four boilers each 2 ft. 6 in. long, an electrically driven dish-washing machine with electric hoist, two electric toasters, urns for tea, coffee and milk, and the usual hotel outfit of ice boxes, warming tables, bain marie, etc. The ice boxes, kitchen and pantries with silver and glass lockers, comprise about 2,400 sq. ft. of deck space.

Because of the great weight involved, the butcher shop, with its ice boxes, is located on the main deck, convenient to the electric elevator.

A steam heating system is provided of sufficient capacity to comfortably heat the vessel in the coldest weather, the main saloons, parlor staterooms and crew's quarters are fitted with standard radiators, while the regular passenger staterooms are heated with sill radiators divided into sections of about 10 staterooms each, all arranged with independent cut-outs and to drain through traps to the main condensers.

The sanitary system provides fresh water under pressure to kitchen, pantries, and bathrooms, and salt water to toilets, which are fitted with flushometers, porcelain bowls and ample drainage.

The general scantling and arrangement of joiner work is best described by reference to the midship section.

Character of Decks.

In general the decks above the main deck are of 7/8-in. tongue and grooved pine nailed to pine carlins of the scantling shown, all spaced 19-in. centers, stiffened by a steel structural comprised of channel beams 12 ft. 8-in. centers riveted to 8-in. I-beam steel girders extending fore and aft under stateroom bulkheads, supported by iron pipe stanchions riveted at top and bottom, or wood stanchions with 5/8-in. iron rods extending from deck to deck, rods spaced 12 ft. 8 in. centers and wherever possible these rods pass through and are nutted under the iron beams. All saloon deck girders are so situated that these rods pass through and are secured to top flange. The bulkheads between staterooms are of tongue and grooved pine alternately 7/8-in. single thickness and 5/8-in. double thickness planked diagonally, nailed through with clinched nails. The double bulkheads are located at the iron carlins and fastened to them to obtain necessary athwartship rigidity.

General Arrangement of Staterooms.

The general arrangement of staterooms provides three rows of staterooms on each side of saloon and gallery decks. The staterooms opening from the saloons are ventilated by concealed openings to the saloon and transoms opening over the upper deck of the adjoining outside rooms, the height of which is reduced for this purpose. The outer rows of staterooms have windows opening on the passageways and the outside of deck house respectively.

There are in all: 8 staterooms for crew, containing 192 berths; 41 staterooms for officers, containing 111 berths; 420 selling rooms for passengers, containing 826 berths; 45 free berth rooms, containing 460 berths.

On the main deck forward are accommodations for 36 women and 78 men emigrants. These quarters are fitted with galvanized iron pipe berths with canvas bottoms and hair mattresses. There are 300 spare mattresses for the use of passengers in the saloons, make a total of 2,003 mattresses.

The location of the dining room on the upper deck, with its attendant weight, necessitated a departure from the usual construction in steamers of this class. In order to support this weight, I-beam girders were run under this deck and the entire structure supported by stanchions extending through the main saloon. In order to furnish a base for decorative treatment, double groined arches were fitted between these stanchions.

Progressive Speed Trials.

Mr. J. H. Gardner: When we were asked to write this paper on the Commonwealth we regretted that no trial trip data was available as the vessel was put into regular service immediately on completion, and on account of the large amount of travel she could not be spared until Saturday, Nov. 14, at which time progressive speed trials were run over the government course in Narragansett Bay for the purpose of determining the indicated horsepower at various speeds and comparison with the data obtained from the model experiments at the government tank at Washing-

PROGRESSIVE SPEED TRIAL RESULTS OF STEAMER COMMONWEALTH.

	Direction.	Time.		Steam Pressure Engine Room Gage.	Average Revs. Per Min.	Average Revs. Per Min.	Speed Knots.	Speed Statute Miles.	App. Slip Outside of Buckets. Per cent.	Indicated H. P.	Eff. H. P. From Model.	Prop. Coeff. Per cent.
		Min.	Sec.									
1	S.	3	4	145 / 148	29.51							
2	N.	2	55-1/2	151 / 148	29.74	29.77	20.05	23.09	29.92	12000	5950	50
3	S.	3	3	148 / 147	29.67							
4	N.	2	54	148 / 147	30.17							
5	S.	3	5-4/5	147 / 147	28.62							
6	N.	3	9-2/5	150 / 148	27.56	27.53	18.90	21.76	28.56	8625	4475	52
7	S.	3	12	152 / 152	27.50							
8	N.	3	38-2/5	152 / 153	24.59	24.28	16.65	19.17	28.64	5350	2720	51
9	S.	3	25-1/2	152 / 152	23.97							
10	N.	4	45-3/5	126 / 126	19.62	20.25	13.80	15.89	29.09	3020	1520	50
11	S.	4	6	126 / 126	20.87							
							19.10	22.00		9050	4700	52
							13.90	16.00		3100	1570	50

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ton. The model experiments were carried out on a draught corresponding to 13 ft. mean, or 5,410 tons displacement salt water, trim 10 in. by the stern. The mean draught during the trial on Nov. 14 determined by the observations before and after the runs was 13 ft. ½ in., trim 12 in. by the stern, or 5,430 tons displacement.

The course is one knot long from marks on Jamestown Island at the north end to marks on Rose Island at the south end. The depth of water varies from 20 to 23 fathoms.

The steamer made her regular run from New York to Fall River and after discharging passengers and freight was taken down the bay to the course, where 11 runs were made, starting at about 10:45 and ending at about 2:30. During the first runs the tide was flood, changing to ebb at about 12:45. Time over course, total revolutions of engine on course, and steam pressures, were recorded, and all cylinders indicated at beginning and end of run. These results were tabulated and curves of speed and revolution, and speed and indicated horsepower, plotted and the mean curves drawn.

The first four runs were at 29.77 revolutions per minute, speed 20.05 knots or 23.09 statute miles, indicated horsepower 12,000. The corresponding effective horsepower from model tests was 5,950, which gives a propulsive co-efficient of practically 50 per cent. The apparent slip, figuring at the outside of buckets was 29.92 per cent or practically 30 per cent.

It will be seen from the table that the propulsive coefficient varies between 50 and 52 per cent and the slip between 28 and 30 per cent at the various speeds.

As mentioned the service speed of this steamer varies from 16 to 22 statute miles per hour. The corresponding indicated horsepowers for these speeds are 3,100 and 9,050. This speed trial was conducted under the regular running conditions of the steamer, as to coal, crew, oil, etc. The coal was the regular buckwheat size of the same quality regularly supplied. No difficulty was experienced in maintaining a constant steam pressure during the full speed runs. In fact, on the first run over the course the steam pressure increased three pounds. This is the greatest variation in steam pressure on any of the runs. All runs were made with throttle wide open and variations of speed obtained by the adjustable cut-off on the high pressure cylinders. It may be noted that the last two runs were made with a steam pressure of 126 lbs. as it was impossible to obtain the desired low revolutions on these runs with the adjustable cut-offs, with full boiler pressure without throttling the engine.

I would like to draw especial attention to the 22-mile speed, at which the indicated horsepower was 9,050 and the 16-mile speed, at which the indicated horsepower was 3,100, as showing the different requisites of power necessary for a steamer in the particular service in which this vessel runs.

Mr. F. L. Du Bosque.

Mr. F. L. Du Bosque: Throughout the civilized world the American steamboat has been looked upon with wonder, and it seems to me when we compare the features which are given to us, as existing in this boat, we can think that the idea is justified.

In thanking the authors for the paper, we should not forget that the development of this type of vessel has been due to a master mind, a man who from boyhood has followed the American steamboat, as a special course of study—I refer to one of our vice-presidents, Mr. Stevenson Taylor, to whom I think we should feel under great obligations for developing the type of boat we have had explained to us here.

The statement of the progressive speed trials, which have been submitted, conclude, as they must have hoped, everything that could be desired in describing this vessel.

Mr. Mason S. Chace.

Mr. Mason S. Chace: I am sure we all feel indebted to Mr. Berry and Mr. Gardner for the great generosity with which they have given us the complete details of this vessel, many of which are often regarded as confidential by the naval architect. They have even gone so far as to furnish us with the detailed subdivision of the weight, and a lot of other things. We Americans are perhaps prone to be proud of all we do in ship building, and oftentimes when we build a ship, we claim she is the best in the world, when perhaps we are not justified in doing so—but we make a claim that she is either finer or faster, etc., but I am sure we can all feel positive in making a statement which will not be questioned when we say that the boats of the Fall River line, of which this is an example, are absolutely the finest ships for inland water service that exist in the world. They are in a class by themselves, and are the most comfortable and complete vessels for that character of service that exist in the world, and when we are proud of these vessels, we are proud of something that is distinctly American, and are not exaggerating when we say that they are the best of their kind in the world.

Mr. Clinton H. Crane.

Mr. Clinton H. Crane: In view of what Mr. Du Bosque has said about the goodness of our steamers, it may be interesting to tell you of the comment of one of the best known battle ship builders in Great Britain. Some two weeks ago Dr. John Ingalls, of Point House, was visiting this country, and he made a trip on the steamer Commonwealth. The day after, in my office, he was extremely enthusiastic about this vessel. All of us who know Scotchmen, know what a rare thing it is for a Scotchman to become enthusiastic, and when we find a Scotchman enthusiastic over the work of another nation, it means a great deal.

Paper from J. W. Miller.

Mr. Stevenson Taylor: Mr. President, I received this morning a letter from Mr. Jacob W. Miller, of the New England Steamship Co., inclosing some remarks on this paper, which he has asked me to read. They are as follows:

"Messrs. Berry and Gardner have modestly limited their paper on the steamer Commonwealth to technical details. I feel, however, that the discussion would be incomplete, unless I added a few words of general commendation for those gentlemen who had so much to do with the planning and construction of the vessel. Plans and specifications for a steamer may be most complete, but the perfected ship means the constant supervision of all details by conscientious persons, and one of the great secrets of the success of the Commonwealth, and her popularity with the traveling public is due to the continued watchfulness of the gentlemen who have written the description of the new steamer of the New England Navigation Co.

"The craft which today ply Long Island Sound are creatures of evolution, and in order to fulfill modern demands, each successive steamer must be an improvement over the previous one. The men who build them, and the men who run them must have had long experience relative to the needs of the special service. The Navigation Company was therefore most fortunate in obtaining the advice of Mr. Stevenson Taylor, a

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member of this society, he having for many years made a specialty of Sound steamers, and it is doubtful if any corporation has ever had a pleasanter experience than one I have the honor to represent, during all the time which was consumed in the building of the Commonwealth, the contractors, subcontractors, and the Company working in harmony to bring about the latest and best type of vessel suited to the route and circumstances. I mention these points, for while certain minor changes were made during the time of construction, all the essentials and most of the details of the steamer were put on paper and determined before actual work was begun.

"In these days when arguments are frequently advanced for the use of the turbine for all sorts of vessels and all conditions of trade, it may be well to give the reasons why the side wheel type of construction was adopted for the Commonwealth. As a commercial proposition it is exceedingly doubtful whether or not the turbine is economical on short daily routes on which quite a number of miles have to be made under slow speed. Our experience thus far with the Massachusetts and Old Colony, sister ships, the latter being a turbine, has not shown that the Old Colony's engines are in any way superior economically to those of the Massachusetts. Of course, the problem of repairs and maintenance has not been considered, nor can it be for several years to come."

Mr. Stevenson Taylor.

Mr. Stevenson Taylor: Referring to the remarks made about me personally by Captain Miller and Mr. Du Bosque, I must say that I think they have both been overkind. It has merely so happened that for the past 28 years I have been more or less intimately connected with the development of the Sound style of steamers. The Commonwealth, like other steamers, is the development of years of experience and of many, many minds. In regard to the stopping and backing I think note should be made that that is a very important feature of a steamer like the Commonwealth, and on the trial trip of the Commonwealth, while at sea, running a little over 19 miles per hour, the bells came to the engine room, and progress was absolutely stopped in one minute and ten seconds. I know of no other kind of vessel with which that could be done.

Mr. Gardner in his figures of the results of the trial trip made last Saturday, has given you the apparent slip of the wheels. I wish to call your attention to the fact that that slip is only apparent. For the purpose of comparison I have always used the extreme diameter of the wheel. For instance, in the case of the Commonwealth we call that wheel 31 ft. in diameter, because from the center of the shaft to the extreme bottom of the paddle, when in the water, is 15½ ft., but the actual path traversed by the bucket is not a part of the 31-ft. circle, and therefore the slip given is only comparative, and the actual slip can only be had by taking a drawing of the wheels and figuring it out roughly. I used the experimental diameter of the wheel therefore, only for comparison, that is why it is called the apparent slip.

Electrical Installations on Steamships.[1]

By H. T. Boothroyd.

REFERRING to the system of wiring in grooved wood casing or moldings, this is fast dying out. In cabins and accommodation it has an unsightly appearance, the wires are all concealed, it entails considerable trouble and expense to examine or renew the wires; in machinery spaces it is liable to warp and crack and has a generally untidy and unfinished appearance. It is also liable to fire from short circuits. In the holds it is liable to be damaged by cargo, and if water lodges in any particular place, the casing is very likely to retain it with detriment to the insulation; this might be overcome by using lead-covered cable which would again add to the expense. It does not lend itself to protection the fittings.

If the system of steel tubing is to be at all efficient the tubing must be screwed, inspection boxes fitted to all bends and every fitting should be watertight. This would not be necessary in the accommodation, but would certainly apply to all other positions. In the first place, such an installation would be very much more costly, and it is very doubtful if the result would be satisfactory. Machinery spaces have been so fitted and in a very few years the tubes were completely corroded through, with the result that both wiring and tubes required renewing. In cotton-carrying steamers and steamers with holds insulated for meat, the main cables are sometimes carried through iron tubes on deck alongside winch pipes; in such cases the pipes should be of ample diameter and provision made for draining off any moisture.

The British admiralty practice of wiring is excellent, but the cost would not justify its adoption in the merchant service.

System of Wiring.

There is no doubt that whatever system is adopted, the cost of upkeep will depend in some degree upon the engineers in charge; many of the troubles which occur might well be overcome and repairs effected if the engineers had a knowledge of the causes and the proper method of carrying out such repairs. Engineers have been heard to say that they knew nothing about electricity and did not want to know. Such men are certainly not the best to have charge of electric installations. On one steamer carrying oil in bulk, the mains were led along the deck in iron pipes, a short circuit had developed in the pipe, and when the chief engineer thought it might be put right if he fitted the pipe with oil, which he did, needless to say the result was not satisfactory. In another case where a feed wire to the stokehold was broken, the engineer made the joint by means of the armoring; the result was again unsuccessful.

The method of double wiring with twin wires is sometimes used. The two wires are insulated from each other and laid up together; this system has nothing to recommend it except cheapness. The cables are more liable to be damaged and cannot be satisfactorily repaired, if a fault develops the wires require to be entirely renewed, and the damaged places are often very bad to find, especially if one wire short circuits on to the other. This is a source of considerable expense if it occurs in the holds or bunkers, where they are most liable to damage.

Electrical Power for Auxiliaries.

The subject of applying electric power to auxiliaries is one which is

[1]Abstract of a paper presented to the Liverpool Engineering Society, March 31, 1909.

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bound to claim much more consideration in the future than has been given to it in the past. The first cost is perhaps the most important one, but the economy of working and cost of upkeep would be considerably less than the present system of small engines. In considering such a deviation from existing methods, it is always difficult to prove the advantages until such a system has been tried; the strongest argument against the use of motors in the past years has been that they are not so reliable as the steam engine, and the first cost is much greater. With regard to reliability, a motor constructed on modern designs and up-to-date practice is not more liable to derangement than other machinery, and in fact with proper insulation and protection, there are fewer parts to wear and give trouble than in a steam engine, and given the same care and attention, breakdowns are a remote contingency.

In a report read by Mr. Longridge, of the British Boiler & Electrical Insurance Co., he states that the rate of breakdowns among steam engines for 12 months had been 1 in 10.5, gas and oil engines 1 in 10, electric motors 1 in 8. At the same time an armature or field could be replaced with spares in an exceedingly short time. The oil consumed is much less, there are no steam glands to leak and repack, and further, they are practically noiseless. One of the objections that the oil, steam and water in an engine room would have a detrimental effect on the insulation, would not hold good in actual practice, as most of these objectionable features arise from the auxiliary engines themselves in the shape of drains, leaky glands and joints, and also the splashing of oil from crankpins, swabbing of rods, etc., none of which apply to electric driving.

Auxiliary Pumps.

Dealing with auxiliary pumps, these are usually of the reciprocating type, with the exception of the main circulating pumps; but to the author's mind there is nothing in the duties of the whole pumping installation on board ship which could not be well and effectively carried out by means of electrically driven centrifugal or turbine pumps, specially designed to meet the requirements. Turbine pumps have been made for boiler feed and have worked quite satisfactorily. The required feed regulation can be effected by throttling the delivery of the pump at the check valves. Several well-known firms also make three-throw variable stroke pump for boiler feed—the feed regulation is effected by altering the stroke of the pump rams. The speed of the motor could also be varied within certain limits, by means of a float in the hotwell or feed tank actuating a shunt resistance. Where the amount of water exceeds say 3,000 to 4,000 gallons per hour, turbine pumps arranged to work in series, one coupled to each end of motor spindle, are at present made to deal with considerably higher pressures than are required for boiler feed; for less quantities than the above the three-throw type of pump is recommended.

If centrifugal pumps are adopted for bilge purposes, one of the difficulties that would be experienced is that when the pump has performed its duty of discharging the water and air is drawn into the suction pipe, it will not start repumping without being recharged. This can be simply done by means of a steam charging ejector connected to any convenient pipe. Another point which would require consideration is that the passages by which the water travels to the suction rose would have to be free from obstruction, otherwise water would not flow with sufficient speed to keep the pump supplied. In all other respects the centrifugal pump driven by a motar would be superior to the steam pump, there being no valves to get out of order, no reciprocating movements, wear and tear is infinitesimal, the only parts which would be likely to require renewing are the carbon brushes on the motor.

Main Pumps of Centrifugal Type.

The main circulating pumps as now fitted are almost invariably of the centrifugal type, and it is surprising that motors have not been adopted for this purpose, the conditions being in every way suitable, the load being practically constant, electric motors would be an ideal method of driving. The author believes that this system of driving ballast pumps, wash deck pumps and sanitary pumps has been adopted by the admiralty, who are fully alive to the advantages. Motor drive for turning gear for the main engines has been adopted in the latest Cunard steamers. Electric ash hoists have been successfully installed for some years in cross channel steamers and naval ships, they have a very great advantage in being much more silent than steam engines and quite as easily handled. A familiar type is arranged to work by means of friction discs fitted inside the drum, half the discs engage with feathers in the drum, and loose on the shaft, the other half engage with feather keys on the shaft; the lowering is done by letting the barrel revolve free, the motor runs constantly in the same direction, an automatic arrangement is fitted to prevent overwinding. The whole arrangement is very simple and not liable to get out of order.

Electric Drive to Steering Gear.

The application of electric drive to the steering gear is perhaps not quite such an easy problem as the other cases mentioned, as the conditions are much more complicated, but surely any machine which can be driven by means of a steam engine, can also be driven electrically. Remembering what has been done in textile mills, colliers, steel works, etc., the steering gear problem is not insurmountable if tackled without bias. The power required is intermittent, it must be applied instantly in exact proportion to the work required, and the starting and stopping must be automatic and correspond to the steering wheel. These conditions could be achieved by means of a shunt wound motor, coupled to the ordinary gear instead of the usual engines, the shunt being excited direct from the main generator, the current for the armature being taken from the dynamo side of a motor generator, the motor taking current from the main generator. The shunt of this dynamo would also be separately excited from the main dynamo, a regulating rheostat would be inserted in the field, and also a reversing arrangement fitted, both to be actuated by means of the existing steering wheel in the wheel house. When the steering wheel is in mid-position the dynamo field would be cut out and the whole resistance in the shunt; as soon as the wheel was moved in either direction, the field circuit would be made to operate in the same direction, and at the same time would commence to cut out the resistance, allowing the dynamo to generate sufficient current to operate the steering motor; as soon as the steering wheel came to rest, the motor would be stopped by means of the existing differential gear, which would cut out the field and bring the lever back to its original position in exactly the same manner as it would close a steam valve, and in the same way if the steering wheel were moved rapidly round to port or starboard, it would cut out the whole resistance, and the motor would run at full speed so long as the steering wheel was kept moving; stops would be fitted as at present, so that the wheel could

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not be moved too rapidly and so injure the rheostat.

Another method would be by means of only one motor, series wound and fitted with electric brake, which would come into action as soon as the current is cut out. The necessary starting and regulating resistance would be actuated by the steering wheel and differential gears in the previous method.

Electric Gear on the Faraday.

From this it will be seen that the only alteration necessary to existing gears, would be the replacing of the steam cylinders with a motor, and perhaps a slight modification of the differential gear. There are of course other methods which could be applied, but the above appears to meet most fully the requirements, the speed regulation of the motor could be varied from a few revolutions to full speed, and there would be no tendency for the motor to overrun, as the armature current would be reduced gradually and the motor stop, when the position of the rudder corresponded with the position of the steering wheel; there would be no sudden shocks to the motor or gear; a comparatively small motor could be fitted, as the full load would never be required for more than one to one and one-half minutes, and in ordinary working for very much shorter periods. The motor generator could be made to take up very little space, as it could naturally run at a high speed, and it is doubtful if the first cost would be much more than that of a steam engine with double cylinders, and steam and exhaust pipes. The gear would be much more silent and efficient.

In a paper read by Alex. Siemens, M. Inst. C. E., on Sept. 20, 1899, before the British Association, he explained an electrical steering gear on steamship Faraday, which gave complete satisfaction. A shunt motor turned the shaft of the steering gear backwards or forwards by means of electric clutches actuated from the bridge, and the current was interrupted by the rudder head, getting a new impulse from bridge when required to move again; an indicator showed the quartermaster the position of the rudder, and the contact apparatus was in the shape of a small steering wheel as usually fitted in the wheel house.

Operation of the Windlass.

The windlass offers certain difficulties to motor drive, but probably none which could not be overcome, and when the comparatively short time that it is in use and the distance it is from the main boilers is borne in mind, it is evidently suited for electric driving. The motor would have to be of ample B. H. P. to deal with the heaviest load, be reversible, have heavy starting torque and variable speed; these are common conditions which are fulfilled in everyday practice. The principal objections against electrically driven capstans is that the motor could not be made to run slowly and be brought to a standstill when the strain became too great in the same way as can be done by a steam engine. In regard to this, when there is so little steam behind the engine that it can be brought up by the strain on the anchor, it cannot be exerting any great power. On the other hand, if the engine were running full speed and exerting its full power and was suddenly brought up by the strain on the cable, something would be very likely to give away. To overcome such an objection, however, there could be a friction clutch adjusted by means of a spring and hand wheel with an indicator, arranged to be worked near the control gear wheel, so that the motor could be started on the slow speed and the friction clutch set to a predetermined position on the indicator corresponding to the position of the speed regulator; by this means, if the strain became too great for the motor to deal with at the speed it was running, the clutch would slip, the motor could then be put on a higher speed and the clutch tightened to correspond with the speed. This arrangement would prevent any undue strain coming on the motor suddenly and overcome the difficulty of a circuit breaker coming out at an inopportune moment. A circuit breaker should be fitted to come out at say double the full power of the motor; this would also act as a preventative to too heavy a strain coming on the cables. If the motor applied was of the same B. H. P. for a given size of windlass as the usual steam engine, it would as naturally cope with the work it had to do; the maximum time for running at full load would be so short that the motor would not require to be of excessive size and could be arranged to run at comparatively slow speed with a wide speed variation.

Refrigerating Compressors on Cunard Liners.

As an illustration of the flexibility and adaptability of motor drive, motors designed and manufactured by the author's firm for the Liverpool Refrigeration Co., for driving refrigerator compressors on the steamships Mauretania and Lusitania may be instanced. The principal conditions were that they must be absolutely silent, the speed variation was to be as flexible as a steam engine between 40 and 110 revolutions. The starting torque was to be ample to overcome the gas compression without a by pass, the starting and speed regulation was to be achieved by means of a hand wheel, power developed 40 B. H. P. It was at first proposed to have a normal slow speed motor driving through machine cut worm gear, but on further consideration, it was decided that this gear would not be silent as soon as there was any wear, the space required was too great and the cost of gun-metal machine-cut gear for the power required at the slow speed was exceedingly high. The next proposal, and the one adopted, was to make the motors suitable for coupling direct on to the compressor shafts and to develop the required B. H. P. at the revolutions specified. The motors were designed with 12 poles and a comparatively large diameter of armature, to give the required torque; as the power at the higher speed was approximately double that of the lower speed, it was decided to fit two commutators and a double winding at the armature, so that for the first variation of speed from 40 to 75 revolutions per minute the windings were in series, and from 75 to 110 revolutions per minute they were in parallel. The intermediate speeds were varied by means of shunt resistance. The starting and regulating gear was specially designed to meet the requirements, and completely fulfilled all the conditions. It is operated by means of a hand wheel, the first steps cut out the resistance with the armatures in series, and by gradually moving the wheel, the shunt resistance is inserted with corresponding increase in revolutions up to 75, when by moving it sharply across a short space, the armatures are put in parallel and the shunt resistance cut out; on moving the wheel still further, the resistance is again inserted and the speed regulated to 110 revolutions; a locking device is fitted, so that if the D. P. switch is opened it cannot be closed until the handwheel is brought back to starting position. An engraved dial is fitted giving full instructions. These plants have been at work some time now and have apparently given every satisfaction.

Various Uses of Electricity.

The many and varied uses to which

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electric drive has been adopted on the above steamers may be mentioned, from motor-driven hair brushes, meat roasters, plate washers, potato peelers, etc., to the 16 50-horsepower fans for forced draft; fans again for ventilating the fan rooms, fans for ventilating machinery spaces and Thermo tanks for ventilating the ship generally. In the engine rooms motors are used for driving the lifting gear for overhauling the turbines, for turning gear for controlling the exhaust valves, which are 75 in. in diameter, and for centrifugal pumps for drawing off surplus water from the condensers. Motors are also used for two passenger lifts, baggage lifts, two store hoists, two pantry hoists, two mail hoists, four 12-cwt. deck cranes, four boat winches; altogether about 2,000 horsepower in motors are installed.

It is often said that electric motors are unsuited to the rough usage obtaining in ships, but to those who still hold such opinions the above installation is in itself a sufficient contradiction, the more so as in every instance most satisfactory results have been obtained, results which are in great measure due to the improvements made in recent years, both in design and manufacture of direct-current motors.

Electric Winches Considered.

Reverting to the ordinary ship's equipment, the winches come next for consideration; this is a subject which has often been discussed by superintendent engineers, and so far as the author is aware, the principal objection is the first cost—in this respect it would be rather interesting to know what was the cost of an ordinary ship's steam winch when they were first installed—or say 30 years ago. The author's opinion is that if electric winches were in demand to the same extent as steam winches, the cost of installing them would not be much greater, if any, taking into consideration the steam and exhaust pipes, valves, etc., while there can be no doubt as to the higher efficiency, less cost for working and less cost in upkeep, whilst the advantage of quieter running would be appreciated, especially on a passenger steamer. The construction of a suitable winch offers no difficulties, the motors can be made sufficiently watertight to withstand the bad weather and boatswain's hose, at the same time ample ventilation can be provided by means of inlet and outlet pipes, with fin blades fitted to the armature, and this is now a very common practice in fully enclosed motors.

It may be said that winches are particularly subject to rough usage and worked by unskilled men, but electrically driven pile drivers worked by navvies have been installed at the Hull Joint dock for over 12 months, working in the open without any protection from the weather and fixed on gantries in the sea, as well as in the bottom of the new dock. These motors work at a pressure of over 500 volts, and are said to be in every way satisfactory; the advantages over steam drive are obvious, especially in a case where they are working actually at sea, or where coal would have to be carried any distance. The ordinary ship's winch is invariably fitted with a double gear, center barrel and warping ends, but in some cases the warping ends are used for discharging cargo with a loose fall, the winch running in one direction, while in other cases the center barrel is used with a fixed fall and the winch reversed; for electric winches the center barrel could be done away with and the shaft and bearings made strong enough to allow of either end drum being used with a fixed or loose fall, the gear heavy enough to take the full load, and with the speed regulation of the motor taking the place of a double gear, such a winch would be quite capable of dealing with all ordinary freight. Where heavy and bulky pieces have to be handled, a special winch would be fitted at the main hatch where such pieces are usually stowed. It does not appear necessary or advisable that all winches should be alike irrespective of the class of cargo they have to handle.

The type of winch fitted on cross channel steamers of the Great Western railway, has controllers fitted below the deck with the spindle coming up through a cast iron column bolted to the deck and operated by means of a handwheel. The drums are driven by means of machine-cut worm gearing working in an oil bath.

The generating plant which would be necessary to provide for a vessel electrically equipped requires very careful consideration, so that the capital outlay may not be excessive owing to too much power being installed; at the same time it must be sufficient for all requirements and emergencies. The first point to consider is the ordinary demand when the ship is at sea under normal conditions, including the lighting. In the daytime all the lights would not be required, but many of the auxiliaries, such as sanitary pumps, fresh water pumps, etc., would be required more in the daytime than at night, which would help to balance the load. If the number of lights is taken at 600, in the ship under consideration, 75 per cent would be a fair amount to take as a working load. The auxiliaries taking a constant load would be feed pump, main circulating pumps, bilge pump, steering gear; the other auxiliaries would be more or less intermittent. The following will show the approximate power required to be installed:

		B. H. P.
2 main feed pumps, each	6,300 galls. per hour (35 H. P. each)	70
1 auxiliary pump	6,300 galls. per hour	35
1 main circulating pump	230,000 galls. per hour	40
1 bilge pump	6,500 galls. per hour	5
1 wash deck pump	2,000 galls. per hour	3
1 sanitary pump	9,000 galls. per hour	7
1 fresh water pump	2,000 galls. per hour	5
1 ballast pump	33,600 galls. per hour	15
1 steering gear		15
1 ash hoist		3
1 windlass		35
1 turning engine		12
12 winches (say 12 B. H. P. each)		144
		389

say 320 K. W., add 600 lights, say 36 K. W., making a total of 356 K. W. actually required to work the full equipment at one time, but the winches and windlass are not working at sea. The main feed pumps and steering gear are not working at the same time as the winches, whilst the turning gear, ash hoist and other pumps are intermittent. It would be quite safe to install a generating plant for say, 225 K. W., divided into three 75-K. W. sets, each capable of withstanding an overload of 25 per cent for one hour after a full load test of six hours with normal temperature rise, this would give a margin of 25 per cent, or about 270 K. W.

On this basis two dynamos would be ample to deal with the sea load leaving one as a standby, and it will be found that the two generators would be ample to cope with the work when in port. The space occupied by the generators would not be excessive if they were of high-

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speed type coupled to enclosed type forced-lubrication engines, which are almost invariably installed for such powers.

The merits of open type engines as compared with enclosed type, afford considerable scope for discussion, but for smaller outputs up to, say, 30 K. W., the slow running open engine is better for ordinary ship's use.

Electric Night Signalling.

Electric night signalling at sea has now become almost universal—one method used on the United States battleship San Francisco was practically the same as the usual electric lantern, the slides being the letters of the alphabet thrown on a screen, about 12 ft. sq., these letters being clearly visible at a distance of two miles. The method usually adopted in this country is by means of the Morse code. The apparatus adopted by the Admiralty and many liners, consists of a lantern filled with 16 5 or 6-candle power high efficiency lamps in two circular rows, one above the other, and protected by a heavy circular glass screen; the lantern is fixed to the masthead and connected to operating keys on the bridge, one key being usually fitted at the port side of bridge and one at the starboard side. A suitable condenser is fitted in circuit with the keys. The operating keys are of the usual telegraph type and worked in the same way.

There are many other patent types of lanterns on the market which are operated by means of sliding shutters, some are fixed at the masthead and worked from the bridge by means of a cord, others are operated directly on the bridge. The objection to all shutter lanterns is that they cannot be operated with anything like the speed of the Morse key.

An electric sounding apparatus has, the author believes, been patented by Mr. E. J. Watts, of the Marconi Wireless Telegraphy Co., whereby correct soundings can be taken without the aid of a line.

Electric Heating in Passenger Accommodations.

Electric heating is being adopted by many owners for passenger accommodation as being superior in every way to steam. It is simply applied, is cleaner, easily regulated and has no smell. In cases of sickness the invalid can have his cabin heated without interfering with the comfort of other passengers in adjacent rooms and without having a long length of steam pipes in use for one heater. The troubles of leaky joints, glands, etc., on steam heaters are well known to every engineer with sea exprience.

Telephones are being fitted in the latest liners to communicate with a central exchange, so that a passenger can speak to the steward's department or to any other stateroom; when the steamer is made fast the exchange is connected up to the central office, so that passengers can telephone their friends on arrival.

The larger subject of the propulsion of ships by electricity, is one which does not come within the scope of such a paper as this, though one cannot help thinking that at some future time, large vessels will be electrically propelled, but it is hard to conceive that any system of generating current for this purpose on the ship would be any advantage. On the other hand one can readily conceive the immense advantage if electricity could be stored in sufficient quantities to supply the required power. The author is not aware if a comparison has been made between the weight and space occupied by a storage battery as at present constructed, and the weight and space occupied by an engine and boiler installation, with water in boilers and condenser, including coal and bunker space. Such a comparison would certainly be interesting for say a cross channel steamer, running for a short time only.

Electric Drive for Dredges.

A system of electric drive for dredges has been put forward and favorably considered, the conditions being somewhat different to those obtaining on an ordinary steamer. The machinery would consist of two 1,200-K. W. three-phase alternators at 2,000 volts, 50 periods, coupled to steam turbines running at 3,000 revolutions per minute, fitted with suitable switch gear to enable the turbines to be controlled from the bridge and from the engine room.

The propelling motors, two in number, each 1,600-H. P. running at a speed of 250 revolutions per minute, coupled direct on to the propeller shafts.

Four centrifugal pumps, each taking 700 B. H. P. at 300 revolutions per minute.

Four winches, each taking 250 B. H. P. at 500 revolutions per minute.

As the propelling motors would not be required to work when the pumps were working, and the pumps and winches would not be required at the same time, this system certainly offers every inducement for its adoption for such a purpose, both as regards first cost and economical working. It also illustrates a set of conditions where electric propulsion could be applied with the minimum of risk and maximum of economy. Another great advantage of the electric drive would be the ease of control from the bridge. Telegraphs would not be required, as the officer in charge could easily work the regulating gear from the bridge, and so maneuver the ship himself and be directly responsible.

The author believes that when the problem of electric propulsion is finally solved, it will be either with a storage system or induced electricity.

The advantages of electric propulsion, if it is ever achieved without having to install a generator, would be so great as to entirely supersede all other methods of propulsion. If a successful storage battery could be installed in the place of existing machinery, the saving of labor would be enough to lead shipowners to consider the question.

Even with the materials at hand, the author believes that the question would be worth going into for a cross channel service, as one generating plant on shore for charging all the accumulators could probably be kept constantly running with corresponding economy.

JAPANESE SUBSIDIES.

The subsidizing of Japanese ships has resulted in the great increase of tonnage of Japan's merchant marine. The amount of such aid by the general government has increased from $1,726,565 in 1898 to $6,170,566 in 1908. A decrease took place in 1904 and 1905 on account of the war, but the 1908-09 budget carries the largest amount ever devoted by Japan for this purpose. Additional amounts are being asked for and will probably be forthcoming, as for example, the line to South America, which it was found could not be a success without state aid. Following is the detail of the subsidy for 1908-09:

Description.	Subsidy.
Encouragement of navigation	$1,735,009
Encouragement of ship building	993,729
Subsidy to European route	1,331,600
Subsidy to San Francisco route	504,912
Subsidy to Seattle route	325,707
Subsidy to Australian line	212,039
Subsidy to far eastern service	263,940
Subsidy to inland Chinese navigation	399,400
Training of mariners	2,490
Lifeboat work	9,460
For calling at Korean and North China ports	24,900
Coasting service	174,798
Ogasawara (Bonin Island) service	8,466
Islands in Kagoshima	11,354
Oki Island	2,689
Hokkaido coasting service	89,915
Idzu Island service	3,765
Tairen service	69,721
Okinawa (Loochoo Island) service	2,690
Okinawa remote islands	4,482
Total	$6,171,066

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Chains Without Transverse Welds.

(The following article from *The Engineer*, London, describing a new Belgian process of chain making, in which each link is first formed as a laminated ring and welded between adjustable forming rollers, is extremely interesting. The elimination of a scarfed or transverse weld, preserving the continuity of the fibrous structure of the bar and the resulting greater strength, and the uniformity in size and quality of links, together with the speed of manufacture, will doubtless not be without effect on the chain making business in the United States.—Ed.)

THE MANUFACTURE of chain cables has hitherto been conducted in much the same manner as when they first came into use. A round iron bar of the diameter intended for the link, cut obliquely at each of its ends, and of length equal to that of the circumference of the work when finished, is worked by hand or by machine power into an oval form, so that the two tapered ends lie one upon the other. The link thus bent is then brought to a welding heat and the two ends are welded together by hand. In the case of the smaller chains this work can be accomplished in a single heat by one smith, alone or with the help of a striker. For the welding of larger chains, however, several heats, and two or even three strikers, become necessary. The weld is generally arranged at one end of the link, but it is also sometimes to be found in the middle of one of the sides. The strength of the whole chain, of course, depends on the faultless execution of the weld in each individual link; that is to say, everything depends upon the reliability, professional knowledge, and skill of the chainsmith.

Now the difficulty of obtaining an absolutely trustworthy weld increases very considerably with the diameter of the link, and even with the best quality of work it often happens that a thick link is only welded at the outer edge, while the middle remains unconnected; and there are no means of judging by outward observation whether the core is welded properly or not. Only a superficial examination of the weld, and the submission of the chain to a tensile test bearing a certain given proportion to its ultimate strength, can be resorted to. At the same time—that is to say, during the course of the tensile test—every link is struck with the hand hammer.

As regards both the quality and the quantity of the work produced—especially where the cables of our large vessels are in question—the whole method of manufacture no longer satisfies the requirements made upon it, and if the best chain-cable makers in existence still succeed in meeting the demands made upon them, this is largely due to the fact that the chain smith's trade has, in a sense, been bequeathed from father to son for generations past, with the result that the smiths are wonderfully proficient. The manufacture of chains, indeed, has its home only in certain particular districts, in which the whole population is exclusively devoted to it, so that one generation in a manner inherits the experience of its predecessor.

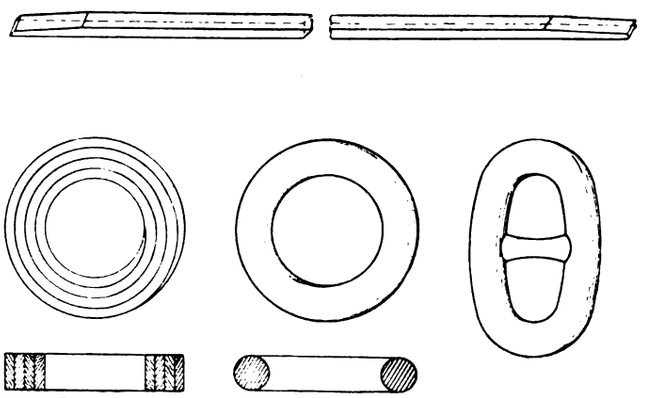

FIG. 1.—STAGES OF FORMATION OF A SINGLE LINK.

To Discover a Method by Machinery.

Under these circumstances it is no wonder that it has for many years been the endeavor to discover a good method for the manufacture of chains by machinery, in order, on the one hand, to attain greater homogeneity and reliability in the product, and make it independent of the personal skill and conscientiousness of the workman, and on the other, to bring the power of production up to the level of the demand. Until recently, however, the manifold attempts in this direction in England, Germany, Belgium and France have not brought any marked success, except in the case of thin chains which are subject to relatively small stresses and which are made of wire. These are for the most part welded electrically after the links have been bent together by mechanical means. Above all, of course, the aim was to avoid the transverse weld—in fact, to make chain links entirely without the joint.

The best known efforts in this direction are perhaps those of Strathern (Great Britain), Oury (France), Girlot (Belgium), and Klatte (Germany). The latter rolled mild steel bars of cross-shaped section, and by means of further rolling and slotting formed them into chain links which hung loosely in each other without any transverse joint in the lengthwise direction of the rolled bar. But in spite of endeavors which have been continued for about 20 years with wonderful ingenuity and tenacity of purpose, the production of large cables and crane chains on a commercial scale has not proved possible, first, because the cost of manufacture was great, and secondly, because the public departments and classification societies expressly prescribe the use of wrought iron as the material for chains.

Description of New Method.

A new method for the manufacture of chains of every kind and size from wrought iron has, however, lately been invented by the Belgian engineer,

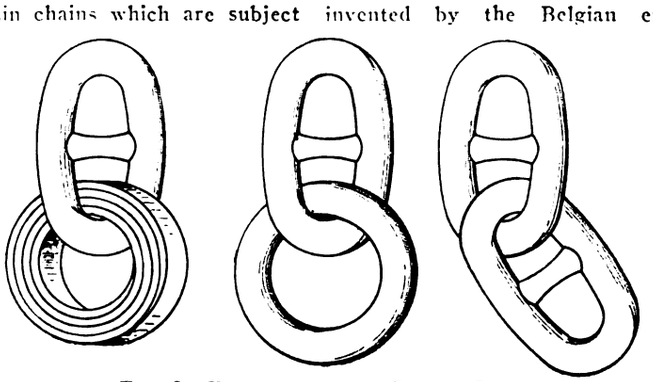

FIG. 2.—FORMATION OF A SECOND LINK.

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Monsieur Alfred Marion, of Brussels. This invention, which appears to fulfil every practical requirement in a high degree, has been patented in all civilized countries. The sole right of working it in Germany, Austria-Hungary, Russia, and some other continental states, has been secured by the firm of A. Borsig, of Tegel, near Berlin, while John Brown & Co., of Sheffield, have undertaken the manufacture of the chains in England.

The method of manufacture is, shortly, as follows: A flat iron bar brought to a welding heat and wound up on itself in layers into a ring of rectangular cross-section is welded solid, and then by means of additional rolls of suitable size and form is worked into a ring of circular cross-section. By means of a hydraulic press and swage, the ring is now made to take an oval form, and in the case of stud-link chains is at the same time provided with its stud, which is then shrunk tightly into place. Through this link now finished is reaved a second flat bar, which is brought to welding heat, like the first one, and wound into a ring, etc., as before. Figs. 1 and 2 show the various stages passed through in order to produce two complete links.

Details of Manufacture.

The details of the manufacture are somewhat as follows: The flat iron bars *b*—Fig. 3—are brought to a welding heat in the furnace *a*. Directly in front of the furnace stands the winding apparatus, consisting of the two pressing rolls *c* and *d*, the fixed mandril *f*, and the guiding bracket *e*. The two rolls *c* and *d*, which turn in the direction of the arrows, wind the white-hot flat iron bar *b* round the mandril *f*, and in so doing weld it into a solid ring. During winding the last link of the finished chain is kept by a holding appliance in such a position that the winding must take place through it, and the ring, when finished, hangs loosely in it. This ring, however, is of rectangular section, and is accordingly, while still at the welding temperature, introduced into the rounding rolls—Figs. 4 and 5—which stand in the close vicinity of the winding apparatus. The rounding machinery consists of three outer rolls g_1, g_2 and g_3, and the inner roll *h*, all of which are formed to the half-round section of the chain. The roller g_1 is fixed; the axes of the rollers g_2 and g_3, however, can be advanced by hydraulic means in the direction of the arrows. The inner roller can also be raised and lowered, and can at the same time be adjusted in the horizontal plane. The manner of working is as follows: As soon as the rectangular-sectioned ring *i*, which is still at a white heat, is introduced into the apparatus, the rollers g_2 and g_3 are pushed forward by hydraulic apparatus from their dotted positions in the direction of the arrows against the outside of the ring, and thus hold it continuously suspended. At the same time, the inner press-roller *h* is moved in a downward direction from its dotted position until it lies exactly at the same height as the roller g_1. It is then moved under a very powerful pressure radially against the latter. Since the roller g_1 turns at an extremely rapid rate, the square-sectioned ring is gradually rolled out to a round section by the closing together of the curved surfaces of the rollers, the weld-surfaces of the bar forming the ring meanwhile becoming more thoroughly united. A rag or fin is formed during this process at the place where the two rollers *h* and g_1 come together. At the moment when the ring is completely formed this is neatly pared off by means of two circular cutters, and falls to the ground.

Process Occupies Only Five Seconds.

From the insertion of the flat iron bar in the winding apparatus to the completion of the round-sectioned ring the whole process above described occupies only five seconds, all the operations being effected in the most simple manner by hydraulic means. The ring hanging in the last link is thus still at a bright red heat when it is inserted in a hydraulic press, and the concluding operations of giving its final oval form to the link and inserting the stud are rapidly performed. The structure of the link sections, given in Fig. 3, clearly show the manner in which these have been built up of flat iron bars wound up on themselves and the excellent character of the welding.

It is, of course, clear that there must be separate rolls and press swages for each size of link, and that the various rolling machines must vary correspondingly in power. At the Borsig works three different sets of rolling apparatus are in action for chains of 25 mm. to 36 mm. (1 in. to 1⅜ in.), 36 mm. to 51 mm. (1⅜ in. to 2 in.), and 51 mm. to 90 mm. (2 in. to 3½ in.) diameter of link metal respectively.

It is evident that, provided the best of wrought iron be employed, machine-made chains of this kind must be of very excellent quality, and, compared with those made by the older methods, they are distinguished by the circumstance that all their links are exactly alike, so that they have a very even appearance.

Moreover, on account of the pressing of the ring into the oval form, there ensues, it is claimed, a strengthening of the section at the ends of the link just where, by reason of its constant friction against its neighbors, it is subject to the greatest degree of wear. The life of the chain is thus prolonged, and its trustworthiness is

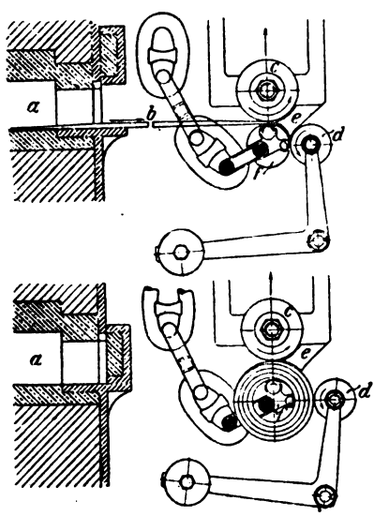

FIG. 3.—REEVING A LINK.

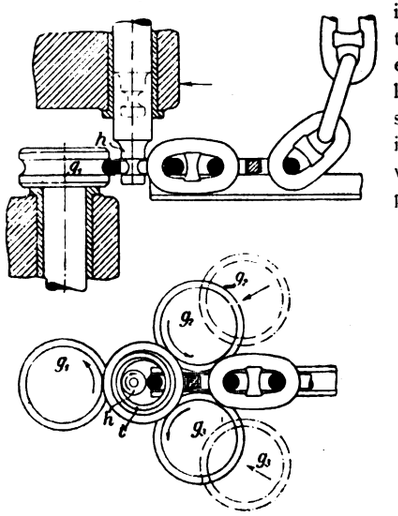

FIG. 4.—ROUNDING UP THE LINKS.

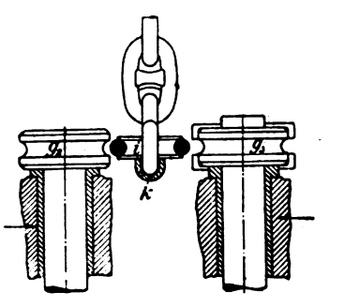

FIG. 5.—ROUNDING ROLLS.

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TABLE OF OFFICIAL TESTS MADE ON THREE-LINK SAMPLES OF BORSIG CHAINS (GROSS TONS).

Diameter of link, metal.	Highest stress reached.	Stress per square inch.	Percentage of elongation.	Tensile stresses and elongations prescribed by German Admiralty: Lloyd's Register. Tensile test.	Germanischer Lloyd. Tensile test.	Bureau Veritas. Tensile test.	Tensile test.	Stress per square inch.	Percentage of elongation.
				Tons.	Tons.	Tons.	Tons.	Tons.	
26 mm. (1 in. +), studless	34.8	21.1	12.8	27.00	28.30	28.30	27.20	16.7	8
26 mm. (1 in. +), stud	35.4	21.4	14.1	27.00	28.30	28.30	29.26	17.8	7
33 mm. (1 5/8 in. —), stud	59.4	22.3	15.7	46.50	45.60	45.60	47.20	17.8	7
36 mm. (1 3/4 in. +), stud	67.9	21.5	13.1	51.00	54.20	52.30	56.10	17.8	7
39 mm. (1 1/2 in. —), stud	76.8	20.6	12.3	61.40	60.40	60.20	65.80	17.8	7
42 mm. (1 3/4 in.), studless	93.25	21.0	14.6	71.75	68.90	68.35	76.40	16.7	8
45 mm. (1 3/4 in. —), stud	103.3	20.8	14.4	77.13	79.10	78.47	87.70	17.8	7
60 mm. (2 3/8 in. —), stud	188.8	21.4	17.4	142.10	140.70	139.50	155.80	17.8	7
63 mm. (2 1/2 in. +), stud	192.4	19.8	16.4	157.50	154.70	153.80	171.80	17.8	7
69 mm. (2 3/4 in.), stud	230.2	19.9	15.8	181.00	178.00	177.85	206.10	17.8	7

increased by the abolition of the transverse welds above mentioned, while the uniformity in the dimensions of the different links insures a smooth passage of a complete cable through the capstan.

Official trials of a large number of such chains are set out in the table above. For the sake of comparison, the tests prescribed by the great classification societies and by the German admiralty are likewise given. It will be observed that the requirements of these various authorities are not only fulfilled, but sometimes very considerably exceeded. As a result of these tests, chains made by this process have been introduced into the German navy.

Red Star Liner Lapland

THE RED Star liner Lapland left Belfast on Saturday, March 27, and after undergoing the usual trials and adjustment of compasses proceeded to Southampton, where she was dry docked by Messrs. Harland & Wolff, Ltd., in the large graving dock in close proximity to their works at that port, after which the vessel went to Antwerp, and from there sailed to New York on her maiden trip.

The Lapland, the latest and most notable addition to the Red Star Line in Antwerp, has been constructed at Messrs. Harland & Wolff's yard at Belfast, and has been greatly admired by all who have had the good fortune to inspect the vessel. She is by far the largest vessel sailing under the Belgian flag, being over 620 ft. long x 70 ft. beam x 50 ft. deep, and 18,565 tons gross register. The vessel has been built in accordance with the requirements of the British board of trade and the American and Belgian laws for passenger vessels, her construction thus illustrating that development of international commerce and unity which the Red Star Line has done so much to promote in its important services between Antwerp and New York, Philadelphia, etc.

The Lapland is designed to carry a large quantity of cargo and a large number of passengers, about 450 first, 400 second and 1,500 third class—for all of whom accommodation on the most approved principles is provided—in fact, the new vessel in every respect will represent the highest excellence of the ship builder's art.

Exceptionally Strong Construction.

The Lapland is an exceptionally strong vessel, having nine decks and being built on the cellular double bottom principle, the double bottom extending the whole length of the ship, the depth of the inner vertical keel being 4 ft. 6 in. throughout, excepting under the engines where it is increased to 5 ft. 0 in., the object of this of course being to give still greater rigidity in the vicinity of the machinery. The vessel has 10 watertight bulkheads, being thus divided into 11 watertight compartments. There is also a center line bulkhead in the cargo holds and 'tween decks. The double bottom, of course, in addition to being an element of strength and security, provides space for water ballast, which is also carried in the fore and aft peaks.

The arrangements for cargo are of the most approved kind. There are six cargo holds, and the bunkers are arranged so that the vessel can be completely coaled from either side. The Lapland is a very sightly vessel, with four masts and two funnels. The cargo derricks are of the tubular type, and the other appliances for working the ship and cargo are also of the latest pattern.

The first class staterooms in the Lapland are placed on the two uppermost decks—on the shelter deck forward and the bridge deck—and are exceptionally spacious and airy. A feature in connection with this accommodation is the large number of one-berth rooms, over 60 such rooms being provided. There are also cabins arranged en suite, with private lavatory and bathroom adjoining. Moreover, all upper berths in first class staterooms are folding berths, which gives a more roomy and tidy appearance than the ordinary arrangement.

Accommodations for Passengers.

The first class saloon is situated on the middle deck forward. This is a magnificent apartment both as regards size and decoration. The framing is paneled in white, relieved with carving and old gold. The dado is in oak, as also the furniture. The saloon extends the full width of the vessel, and the arrangement of the large sidelights in pairs is most effective.

The first class lounge, also the reading room and the first class smoke room, are situated on the promenade deck.

The lounge, situated forward on the upper promenade deck, is a spacious apartment, panelled in oak, designed in the dignified style of early Georgian times, handsomely relieved with carvings. At the after end is an inglenook, with a well-proportioned and noble looking fireplace and overmantel, in the arrangement of which full advantage has been taken of the loftiness of the room.

The reading room is another sumptuous and elegant apartment, situated amidships on the upper promenade deck, the decoration partaking of the pale and trim elegance of the style

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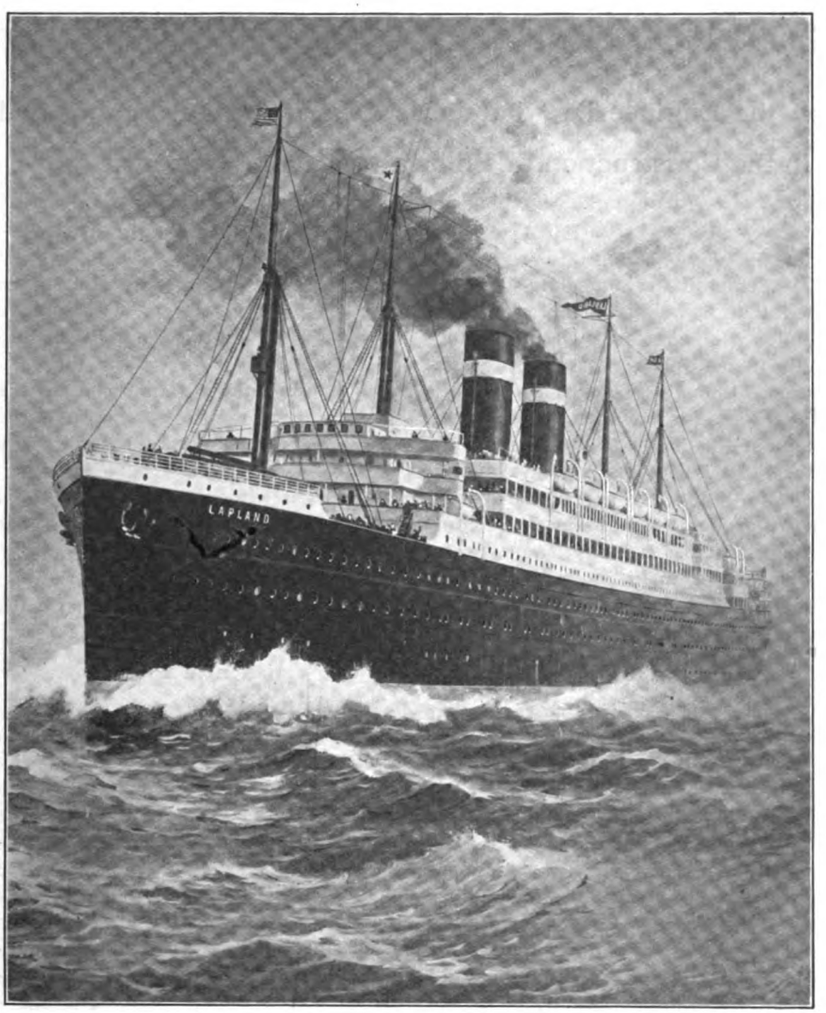

RED STAR LINER LAPLAND.

known as Adam Bros. The walls are of pure white, relieved with handsomely modeled scrolls and trophies. A prominent feature in this room, as in the lounge, is an inglenook, which undoubtedly gives the room a homely and comfortable appearance.

The first class smoke room is also of great height, being 11 ft. 3 in. beam to beam. The framing and dado are of oak, relieved with handsome carving. In the panels there are artistic delph tiles with views of important cities of Belgium, the United States and Great Britain.

Second Class Quarters.

The second class passenger accommodation on the Lapland is very superior. The saloon, situated on the middle deck, will seat 220. The floor is parquetry, with Brussels carpet runners. The room is paneled and framed in pine, finished flat white, relieved with gold. Furniture and dado mahogany; upholstery moquette. The sidelights are arranged in pairs, and there is a handsome sideboard and piano at the forward end in polished mahogany.

The third class accommodation on this vessel is also very suitable. There is a large general room in deckhouse aft on shelter deck, containing a piano, also bar. There is also a shelter forward under the forecastle. A number of hospitals are provided on the upper deck aft.

The Lapland is provided with a submarine signaling apparatus, and Marconigraph house fitted up with the latest improvements for wireless telegraphy.

RECORD RUN FROM VICTORIA TO SEATTLE.

Bucking a head wind the new Canadian Pacific Ry. Co.'s steamer Princess Charlotte recently made the run between Seattle and Victoria, B. C., 85 miles, in 3 hours and 14 minutes, lowering the best previous record, made by the Princess Victoria, by three minutes.

The Charlotte passed Brotchie ledge, Victoria, at 4:17 p. m., and when the slow bell was sent down off the dock at Seattle, it was 7:31. She had made the run in 3 hours and 14 minutes, or at a sustained speed of 22.8 knots per hour. This makes the Charlotte beyond a doubt the fastest vessel on Puget Sound, with the Princess Victoria second in speed, and the Princess Royal and the new steamer H. B. Kennedy close aspirants for third place.

THREE-MASTED SCHOONER OCEANICA VANCE SAILS FROM SEATTLE TO PORT LUDLOW TO SAVE TOWAGE.

With the freight rate for lumber cargoes between Puget Sound and San Pedro, Cal., down to $4.25 per 1,000 ft., B. M., shipowners are using every expedient known in order to reduce operating expenses and make both ends meet. In order to save towage bills, which on short voyages form a large share of the expenses, many ships are using sails where in normal times a tug would be considered indispensable. It is very, very rare that a large ship attempts to navigate Puget Sound under sail and without the aid of a tug, but that it can be done, and be done safely, was demonstrated recently when the large three-masted lumber schooner Oceanica Vance sailed from Port Hadlock to Seattle against a head wind, tacking seven times on the way.

At Seattle the ship was repaired by the Moran Co., and it was decided to sail instead of tow from Seattle to Port Ludlow, where the Vance is to load lumber and shingles for San Pedro.

Accordingly, at 9 a. m., Sunday morning, March 11, the Oceanica Vance was pulled down from her pier at Seattle a short distance into Elliott Bay by a powerful gasoline launch. Here, under command of Capt. Fred Scott, the sails were set and with every stitch of canvas drawing the big vessel proceeded down the sound at a seven-knot clip. It was somewhat risky, for the channel at some places is not over a mile wide, which is close quarters for a large sailing vessel, and the tide runs briskly; but the towage bill was saved.

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Standardization.

A Report on the Work Done by the Engineering Standards Committee on Sections and Tests for Materials Used in the Construction of Ships and their Machinery.*

By Archibald Denny, Esq., Vice-President.

IN OCTOBER, 1900, the secretary of this institution received a letter from the secretary of the British Iron Trade Association stating that, as the result of a proposal contained in a paper read before the association by H. J. Skelton, a resolution had been unanimously passed to the effect that it was desirable a committee should be appointed to consider the whole question of standard and special sizes in structural materials. The letter enclosed a copy of the resolution, and asked whether in the opinion of the Institution of Naval Architects such action would be expedient, and if the institution would be ready to co-operate therein. The reply of the council was in the affirmative as to the desirability of forming such a committee. As to their co-operation they added that their representatives "would more particularly be desired to see that nothing was countenanced which would be likely to unduly restrict the action of naval architects and marine engineers in designing and getting made such new forms and sections of materials as might be necessary hereafter." In January, 1901, the Institution of Civil Engineers (as the result of a motion in council by Sir John Wolfe Barry) appointed a committee to inquire into the advisability of standardizing rolled sections for structural work, and, the three other principal technical societies having been approached for their support, the council of this institution appointed me to attend a meeting of the committee on April 26, 1901. At this meeting it was agreed that, before any final decision was taken, evidence should be obtained from steel makers, merchants, ship builders and engineers, and from representatives of the classification societies, which was done at a later date.

*Read at the spring meeting of the Institution of Naval Architects, March 31, 1909.

The committee immediately recognized that it would be impossible for them as a body to deal with the whole of the items which required standardization, although when we began work none of us foresaw the immense development which has since taken place. It is interesting, in looking back, to note that out of this small but thoroughly representative committee, which ultimately came to be known as the main committee on engineering standards, has grown an organization embracing 39 various sectional committees and sub-committees, with a membership of approximately 300, which deals with interests that intimately affect practically every branch of engineering.

Sectional Material.

The first work to be tackled was naturally that pertaining to sectional material, and, as it was found that radically different sections would be necessary for ship building work, for bridge and building construction, and for railway rolling stock, three chairmen were appointed, with instructions to form sub-committees, care being taken that all interests were represented. The three chairmen were: For bridge and building construction, Sir Benjamin Baker; for railway rolling stock, Sir Douglas Fox; and myself for ship building materials. Our instructions were to formulate lists of sections suitable for each division, to keep in touch with each other, and finally submit a joint list if possible.

My purpose is to present this paper as a species of report to the council and members of this institution of the work done by my committee, and to refer only in general terms to the work accomplished in standardization as a whole.

It was natural that there should be at the beginning considerable divergence of opinion, and while every member recognized the dsirability of standardization, all were not equally hopeful as to its possibility. But a very few meetings sufficed to show that while difficult, standardization was possible, and with goodwill on the part of every member, the work proceeded slowly but surely. The first thing done was to get into close touch with the manufacturers, who gave every facility to the committee, supplied data as to the details of the various sections they manufactured, the practical reasons which governed the sizes and forms of the sections, and in short gave willingly that workshop information without which there could have been no useful outcome to our labors. I believe also that the collecting and collating of that information has not been without value to the manufacturers themselves.

Variation in Profiles.

It was found that there were very wide variations in the profiles between professedly similar sections made by different firms, not only in regard to the radii at the roots and corners, but in proportions of thickness to dimensions. The various practices were plotted diagrammatically and a mean through them formed the basis for discussion, and a method of reconciling the differing interests of manufacturers and users.

Taking now the different sections *seriatim* in regard to equal and unequal angles, it was decided, after very careful consideration, to depart from the practice of tapering the flanges, and the committee recommended the adoption of the technically superior form of section having parallel flanges. They specified thicknesses at which practically correct profiles could be obtained and the range of thickness for each size, and they standardized the radii at root and toe.

For bulb tees, plates and angles, Lloyd's already had sketches in their rules of bulb profiles, and these were practically adopted by my committee, but they made an important improvement in deciding that the standard web should be of the least thickness in proportion to its depth which was consistent with ease in rolling; that is to say, that the material should be arranged to obtain the best strength value possible without adding to manufacturing costs. At the same time, they took care that the standard section should be one in which there is sufficient material to provide a margin for corrosion, an important ele-

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ment which a naval architect must always keep in view.

Dealing with Channel Sections.

When we came to deal with channel sections, whose use is somewhat modern, it was found that practice had developed in the wrong direction, owing to the rolls having been cut to supply special orders of specified thicknesses, without reference to any general principle of design or distribution of material, and to the fact that in rolling channels the flanges must remain of a constant thickness, as the only way to increase the strength or weight of any particular section by adding thickness to the back of the web, and it was quite usual in ship building practice to have channels with webs very much thicker than the flanges. This was obviously wrong in principle, and for the minimum thickness of the standard sections for ship building my committee made the webs 2/20 of an inch less in thickness than the flanges, the webs being kept sufficiently thick to provide a margin for corrosion, and a reasonably proportionate section. A study of the table of the standards, as published, will show that there are certain sections, *e. g.*, the 6-in. by 3-in. channels, which are given in two profiles, and that one of them has a thinner web than the other. This thinner section is used by the underframe builders for railway rolling stock, and is stronger in proportion to the weight of material than the ship section, but my committee did not see their way to go so far with ship sections as the underframe makers felt was desirable.

The **H** girders which were got out by the bridge committee have webs much thinner than the flanges, but these sections have not hitherto been greatly used in ship building, while they indicate the line of economical development in sectional material.

We dealt with **Z** sections in practically the same way as with channels, and as **T** sections are not greatly used in ship building, it was decided to leave this part to be dealt with by the bridge committee.

The maxima and minima for the thicknesses of all sections were settled only after a thorough discussion of the technical and practical necessities of each case, discussion in which the voice of the steelmakers had great weight. I have thought it right to publish the considerations that weighed with my committee in deciding upon the profiles.

After this preliminary work was completed, the important point was taken up as to how many sections should be standardized, but here strong conflicting interests were at once evident, and the final result was a compromise—that method of arriving at a decision which is so peculiarly British, and so practically effective.

Eliminating Multiplicity of Sections.

It was thought essential that something ought to be done to arrest the continual increase in the number of sections demanded from the rolling mills, and therefore in the number of rolls which it was necessary for the steelmakers to keep. This multiplication of sections was accomplished by no commensurate practical advantage, and it brought in its train very serious drawbacks, such as delay in delivery, when small quantities of material were required, because the manufacturers had to wait until a sufficient number of orders had been received for a particular section to warrant the putting in of the set of rolls, or to warrant the cutting of special rolls. These rolls, when once cut, might only be used again on rare occasions, thus involving the steelmakers and the users in unremunerative expenditure. The extent to which this had ben carried was emphasized in the evidence laid before the main committee by a steel maker, who asserted that eight-tenths of the special rolls which his firm had been obliged to cut were never again required. The sums wasted in this way must have been very considerable in view of the fact that the cost of a set of rolls is roughly £200.

It was only natural that the steelmakers should desire to work with the fewest number of sections possible; but, on the other hand, the shipbuilders and classification societies wanted to have the very fullest range which could be obtained. Between these opposing views the committee struck what I hope may be regarded as a happy mean; in any case, the number of sections standardized was very considerably less than the total number of sections published by the different steelmakers. The advantage of having a standard profile laid down is now, I think, fully recognized by all, and there does not appear to be much complaint as to want of comprehensiveness in the lists.

Conferences between the committees were arranged, with the result that the final standard lists contained the following number of sizes:—

Equal angles	16
Unequal angles	30
Bulb angles	20
Bulb tees	6
Bulb plates	7
Z bars	8
Channels	27
Beams	30
T bars	22

Making Existing Sizes Uniform.

In any list of standards it is clearly desirable that the increments in size should be such that uniform and proportional increments in strength and weight will be maintained throughout the series. Practical considerations in regard to existing sizes in current use made it obvious that it would be impossible to design a purely theoretical series, and that the best solution under the circumstances was one which would bring in as many existing sizes as possible, while so arranging their weights that the list would be as nearly uniform as practicable. Diagrams were prepared giving the ideal solutions, and the figures given by the standard sizes when plotted thereon showed that the sizes agreed upon lay very evenly along the ideal lines. When the exigencies of ship building require additions to the standard lists it is hoped that the sizes so added may approach the ideal sections as nearly as practical conditions will permit, and that when the steel makers are preparing to make rolls for such sections, they will, before actually cutting them, consult the standards committee as to the dimensions which should be adopted, as by this means only can uniformity be maintained and the full benefit of the work of standardization be reaped.

It will be observed that the profiles are stated in inches and fractions of inches for the flanges and webs, and in decimals for the thicknesses. This latter point was a little difficult to decide, because the admiralty and the three classification societies had each a different method; the admiralty specified in pounds per foot, Lloyds in 20ths of an inch, the Bureau Veritas in 16ths and 32ds, and the British Corporation in 40ths. The committee finally decided to use decimals of an inch for thicknesses, adopting steps of .025 of an inch, this leaves the various bodies free to specify their thicknesses by any unit they please, the standard profiles only being fixed and expressed as is noted.

During the early discussions of the committee evidence was laid before them of the trouble and vexation caused in the steel works by the different methods which were in vogue in regard to ordering and measuring

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sections. Some bodies ordered and accepted their sections purely on the basis of dimensions and weight per foot run, independent of thickness; other bodies ordered and accepted the material only on the basis of dimensions and thickness, independent of weight, while others again attempted to work on both systems at once. The committee, therefore, when publishing for the first time the sizes and sections, recommended that they be ordered by the leading outside dimensions and thickness, or by the leading outside dimensions and weight per foot run, but not by both.

Full Particulars of Sizes and Form.

It is obvious that in such a comparatively rough manufacturing process as that of rolling sections (where a slight difference in some dimension may produce a disproportionate increase or decrease in weight) to tie makers down to produce standard sections with extreme accuracy, both in regard to dimensions and weight, is an unnecessary hardship, and would increase the cost without any proportionate benefit to the ship builder. As very considerable interests and sums of money are involved by the introduction of standards, especially in an important industry such as the production of rolled sections for ship building purposes, the committee felt that the best interests of all concerned would be served if steel makers were given early intimation of the proposed standard sizes, together with particulars of their dimensions of ordinary manufacture—an opportunity should be afforded to return them in accordance with the proposed standards. To meet this view the committee published, at as early date as possible, full particulars of the sizes and form of profile of the different sections.

The calculations involved in the preparation of tables of moments of inertia, radii of gyration, etc., occupied a very considerable time in view of the care necessary in the production of such tables, and while those tables were in course of preparation steel makers without any brusque change of policy were enabled gradually and at the minimum cost to bring their rolls into line with the new standards.

Co-operation Between User and Rolling Mill.

I venture to hope that the co-operation which has existed in my committee between the various specifying interests, those concerned in the production of the sections and those responsible for their utilization in the construction of ships, has been the means of enabling each to appreciate the difficulties which the other has to overcome, though the interests must necessarily sometimes be of a conflicting nature. Evidence which has been collected by the committee has brought out the fact that the recommendations in regard to standard sections have been widely, if not universally, adopted by the rolling mills of this country, and that when standard sections are adhered to, promptness of delivery and dispatch are the result.

In days gone by it was no uncommon thing for the rolling mills to approach the ship builder and to suggest numerous alterations in the list of sizes. This may have been due to the request by the ship builder for sizes which, though advertised in the makers' section books, had become obsolete, or may have been due to the introduction of special sections to meet special requirements, but I would take this opportunity of urging upon my confreres, when preparing designs and subsequent lists of sections, to adhere as closely as possible to the standard lists, as they are thereby studying their own interests in regard to delivery and cost, through saving time and trouble at the mills.

A practical instance of how co-operation between user and rolling mill may either facilitate or hinder production is aptly illustrated by an instance cited by Sir John Wolfe Barry in his lecture before the Institution of Engineers and Ship Builders in Scotland in December, 1908, of an architect desiring to use about 200 tons of a non-standard section which differed only in very minor details from the nearest standard section. The contractors asked permission to substitute the nearest standard section, but were not allowed to do so, with the result that a set of special rolls costing about £200 had to be cut and the price of the 200 tons was increased by this amount. Thus the architect's clients had to pay £200 extra for the privilege of using a non-standard section which, with a small amount of give and take, should have been saved.

Opposed to Chemical Tests.

The divergence which existed in the tests called for when the committee began its operations was considerable, the requirements of the various bodies crossing and re-crossing, so that if material had to be tested to pass two of the inspecting bodies, it became a matter of considerable difficulty on account of the narrowness of the limits available. The first general discussion showed clearly that the committee were entirely against specifying any chemical tests for plates and sections. They decided that suitable mechanical tests, such as had been applied heretofore, combined with practical working in the factories was all that was necessary, and that the chemical composition of the material was the concern of the manufacturer, who had to produce his material in such a way that it would pass the practical and stringent tests specified. This view did not commend itself to all sections of the standards committee, and though the necessity for a chemical analysis had not been felt by such an extensive user of steel as the British admiralty, nor had the experience of the classification societies pointed to the desirability of having one, it was deemed advisable to follow the line of least resistance and, in the case of material for other purposes than ship building, for which it had been customary to stipulate a chemical analysis, such a requirement has been incorporated in the standard specifications.

Some of the existing rules called for a longer test piece than that represented by 8 in. between the dabs, which requires an over-all length of about 16 in., and the steel makers estimated that the restrictions of all test pieces to this length would effect a very considerable monetary saving, so that it was decided to make 8 in. the standard distance for all plates and sections.

Alternative Standard Test Piece.

In dealing with round bars, a gage length having a ratio of eight times the diameter has been adopted as giving a roughly comparable elongation with that of the plate specimens, and when the bars are turned down it is stipulated that the length of the parallel portion shall not be less than nine times the diameter in order to eliminate the influence of the shoulder and larger ends of the test piece. At a subsequent date the committee were approached by the steel makers with a request that provision might be made for the use of a shorter test piece in the case of bars having a diameter of over 1 in., because in the case of boiler stays many of the steel works had testing machines which were capable of breaking such bars without having them turned down, but the length of the test piece was restricted by the distance between the grips. It was urged that a great saving in material and in cost of preparation would be obtained by the adoption of a shorter test piece. After careful consideration and experiment it was decided to provide an alternative standard test piece (test piece F)

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COMPARISON OF TESTING REQUIREMENTS FOR STEEL USED IN THE CONSTRUCTION OF SHIPS AND THEIR MACHINERY LAID DOWN BY THE ENGINEERING STANDARDS COMMITTEE.[1]

MATERIAL	TENSILE TESTS. Tensile Breaking Strength Tons per sq. in.	TENSILE TESTS. Minimum Extension per cent on Standard Test Piece.	TENSILE TESTS. Standard Test Piece.	TENSILE TESTS. Number.	BEND TESTS. Size of Test Piece	BEND TESTS. Radius of Bend	BEND TESTS. Angle of Test	BEND TESTS. Number	PROCESS OF MANUFACTURE
STEEL PLATES —									
For Ships	28-32	20 for .375" and above 16 below .375"	A	1 each charge, 2 if charge exceeds 25 tons	Not less than 1¼ in. wide	Equal to 1·5 times thickness.	180°	1 cold or 1 temper from each plate as rolled	Open Hearth. Acid or Basic.
" Ships (for cold flanging)	28-32	Do	A	Do.	Do	Do	180°	1 cold from each plate	Do
" Marine Boilers	28-32	20 for .375" and above 17 below .375"	A	1 each plate. Plates over 2½ tons, 1 each end.	Do	Do	180°	1 cold or 1 temper from each plate as rolled (f)	Do.
" Marine Boilers (for flanging)	26-30	23 for .375" and above 20 below .375"	A	Do.	Do	Do	180°	Do	Do.
STEEL BARS AND SECT. MATERIAL —									
For Ships	28-33	20 for .375" and above 16 below .375"	A or B	1 each charge, 2 if charge exceeds 25 tons	Do.	Do.	180°	1 cold or 1 temper from each Bar or Section as rolled	Do
" Marine Boilers (Angles and T Bars)	28-32	20 for .375" and above 17 below .375"	A	2 each charge (c)	Do.	Do.	180°	Do.	Do.
" Marine Boilers (Combustion Chamber Stays)	26-30	23 for .375" and above 20 below .375" (a)	B or F	Do. (c)	Do.	Do.	180°	1 cold and 1 temper from every 15 Bars as rolled from each charge.	Do.
STEEL RIVET BARS —									
For Ships	25-30	25	B	1 each charge (d)	—	—	—	—	Do.
" Marine Boilers	26-30	25 (a)	B	2 each charge (c)	—	—	—	—	Do.
STEEL FORGINGS —									
For Marine Work	28-40 Not more than 4 tons between any max. and min. specified.	29·17 Quality Factor 57	C or D	At least 1 each forging	1" wide by ·75" thick	Up to 32 tons max. tensile ·25"	180°	At least 1 cold each forging	Do
					Do.	Above 32 up to 36 tons max. tensile. ·375"	180°	Do.	
					Do.	Above 36 up to 40 tons max. tensile. ·625"	180	Do	
STEEL CASTINGS —									
For Marine Work, Grade A	35-40	15	C, D, or E	At least 1 each charge (m).	Do.	1"	90°	At least 1 cold each charge (m)	Do.
Do. B	26-35	20	Do.	If casting made from more than 1 charge at least 4.	Do	1"	120	If casting made from more than 1 charge, at least 4.	Do.
Do. C	26-35	15	Do.		Do.	1"	90		Do.
Do. D	—	—	—	—	—	—	—	—	Do.

(a) When tested on gauge length of 4 dia. (test piece F) the elongation shall be 28 and 24 per cent, respectively. (c) When number of bars from one charge exceeds 15, one additional test for each further 15 or portion thereof. In round bars of 1¼ dia. and under the number shall be 50 in place of 15. (d) When weight of bars exceeds from one charge 10 tons, one additional test for each further 10 tons, or portion thereof. (f) Plates over 2½ tons, one cold and one temper, from opposite ends. (m) Small castings, 1 for each pouring head. (s) When tested on gauge length of 4 dia. (Test-piece F) the elongation shall be 30 per cent.

[1]Tons of 2,240 lbs.

having a gage length of four times the diameter, for bars having a diameter over 1 in., the equivalent elongation being approximately one-fifth more than that for a test piece having a gage length of eight times the diameter. It frequently happens that an 8-in. gage length is impracticable for castings and forgings for marine work, so that standard test pieces of fixed gage lengths of 2, 3 and 3½ in. with areas of ¼, ½ and ¾ of a sq. in. respectively (test pieces C, D and E) have been adopted to meet these cases. The extensions on these test pieces are not directly comparable with those obtained on the test pieces adopted for rolled structural material (test pieces B and F), but are directly comparable with each other.

In addition to test pieces for the purpose of ascertaining the tensile strength, standard bend test pieces for marine castings and forgings have also been devised. A considerable amount of experimental work was carried out in this connection, but it was considered preferable to recommend three dimensions for the internal diameter of the bend, as follows:

Range of tensile strength. Per Square Inch.	Diameter of Inside Bend. Inches.
From 28 up to 32 tons	½
Above 32 and up to 36 tons	¾
Above 36 and up to 40 tons	1¼

By the introduction of the standard test pieces the engineering standards committee has not merely facilitated the work of the test room and relieved the steel makers to a very large extent from the expense of preparing different sized specimens of the same steel to comply with the various regulations of the several inspecting bodies, but by rendering test results comparable they will have placed at the disposal of the next generation of engineers and ship builders a mass of valuable information which would not otherwise have been available.

Breaking Stresses and Elongations.

The standard test pieces having been decided upon, it now became possible for the committee to deal with the breaking stresses and elongations to be demanded.

The table appended to this paper shows in a few lines, and more clearly than pages of printed matter, that the committees set before them a high ideal as to the nature of the tests to be demanded and indicates, as the result of a great amount of work and discussion, the extent to which they have been successful in harmonizing hitherto divergent tests.

The letter press of the standard requirements led to a considerable amount of discussion, but as the British admiralty, the board of trade, and the three classification societies had all published very full and carefully thought out rules, it became largely a question of welding these into one, which was eventually and successfully done. We made our report upon the material for ships and boilers in December, 1904, and these reports were also accepted *simpliciter*.

Standardizing Tests for Iron.

The committee had also before them the advisability of standardizing tests for iron, and this work is still in hand, but has not made such progress as we would all have desired. Up till now, none but practical tests have been made obligatory by any of the classification societies except one; that is to say, that no test pieces were required to be broken or bent before delivery of the material, as in the case of steel. It is also true that iron is not now a general constructional material for ships or boilers, still it is used in the case of anchors and cables, rigging chains, slings and general smith work, and the committee have felt it desirable, and they are now engaged in making an attempt to standardize a few clearly defined classes of iron. There are a great number of different marks, or brands, of iron, and by these marks it has hitherto been sold. We are informed by the iron makers that it is impossible to

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lay down general tests for iron, as it varies so much in the different localities, but personally I am hopeful that we may bring something like uniformity out of chaos, and that while vested interest may fear the effect of this, practice will show that their fears are groundless.

In dealing with the important matter of testing requirements for such bodies as the admiralty, the board of trade, and the classification societies, who have enormous quantities of material under inspection at one time, it is evident that no abrupt or sudden changes could be tolerated, and that ample time must be given, first for the consideration of the suggested tests by those in charge, and, secondly, for the gradual introduction into practical work. The admiralty have signified their acceptance, and the board of trade have revised rules, which are practically in accordance with the recommendations of the committee, and which came into force in August last.

Lloyds Register, in the latest revision of their rules, have altered the same, both in regard to sections and tests, to conform to the recommendations of the committee, which their chief surveyors were largely instrumental in preparing. The recommendations of my committee have also for some considerable time been adopted by the Bureau Veritas and the British Corporation.

It will be seen that the work of this committee has been no sinecure, it has been going on now for years, and I have regretfully to record that three of those who sat with us have joined the great majority. Is there any other country than the United Kingdom where so many hardworking business men could be found, who are willing, without fee or reward, to spend a vast amount of their valuable time in public work such as this, for which there is not only no fee, but no allowance for traveling, or other expenses?

It must not be thought that standardization means fossilization. It is provided that not less than once a year a meeting shall be held for the purpose of considering whether any deletions, additions, or alterations are required, and two such meetings have already been held.

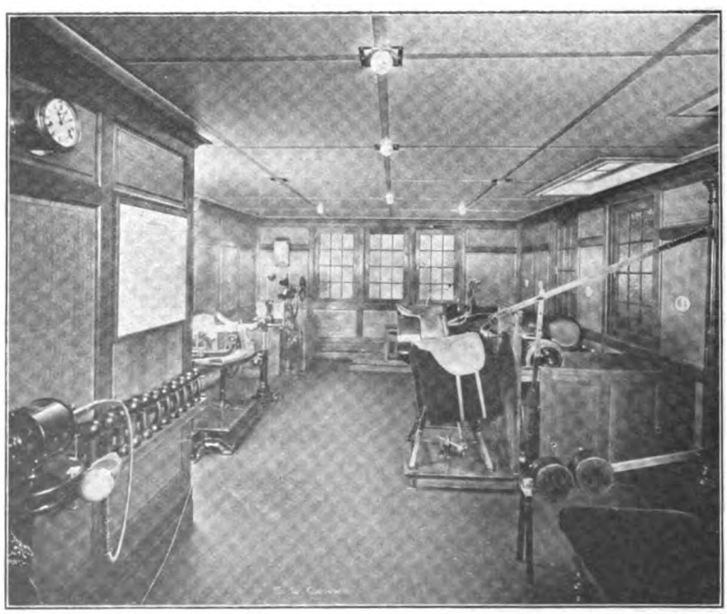
I have now made my report on what has been done by the committee in which this institution is most immediately interested, and, as Sir John Wolfe Barry has recently read a paper upon the whole subject of standardization, it is needless for me to do more than outline what has been done.

The New Hamburg-American Line Steamer Cleveland.

THE STEAMER Cleveland, the latest addition to the fleet of the Hamburg-American Line, arrived recently at New York on her maiden trip to the United States in the New York-Hamburg service. The Cleveland was launched at the yards of her builders, Blomm & Voss, Hamburg, on Sept. 26, 1908, the occasion being noteworthy in that she is the largest vessel ever built at Hamburg. Her sister ship, the Cincinnati, is nearing completion, and is expected to enter the service in the near future.

The general dimensions of the Cleveland are: Length over all, 608 ft.; beam, 65 ft.; height, from water line to upper deck, 55 ft. Her propelling machinery consists of two sets of quadruple expansion engines of 4,650 H. P. each; average revolutions, 80 per minute, and speed of vessel, 15 knots. Steam is gener-

FIRST-CLASS SMOKING ROOM OF HAMBURG-AMERICAN LINER CLEVELAND.



GYMNASIUM OF THE HAMBURG-AMERICAN LINER CLEVELAND.

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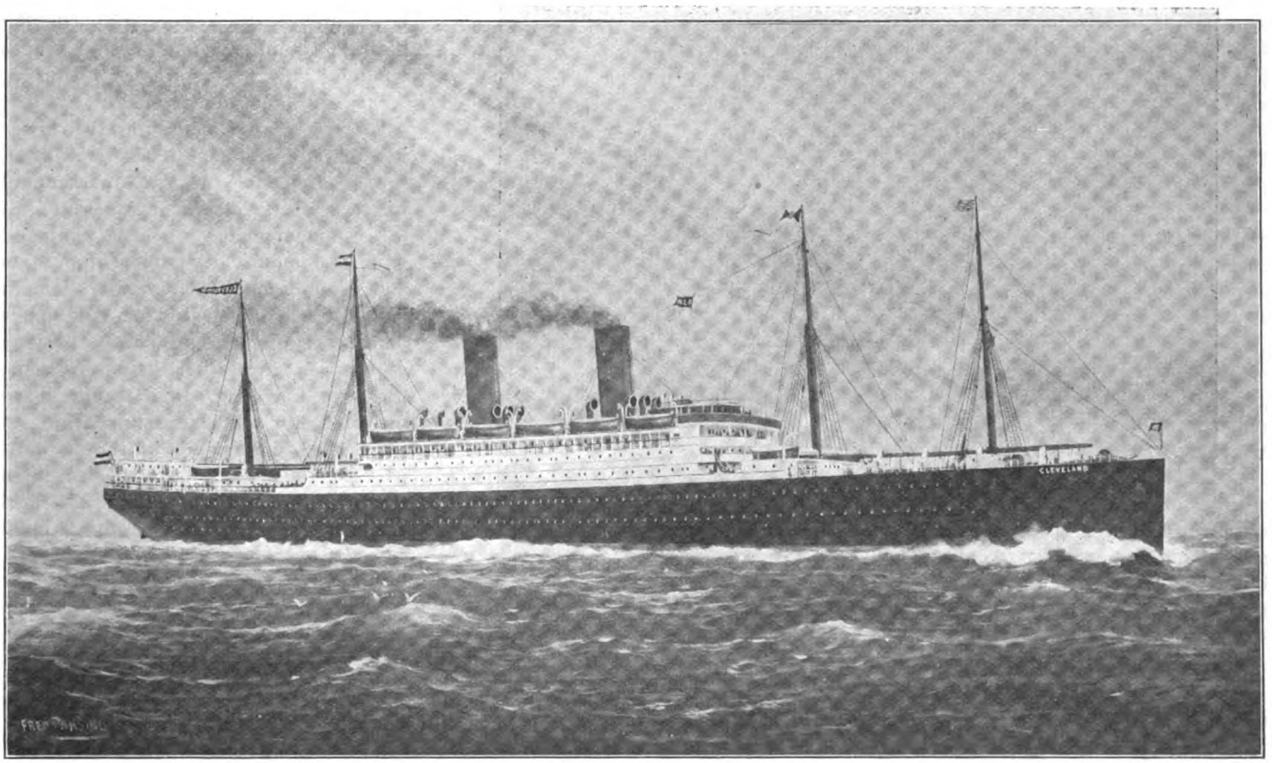
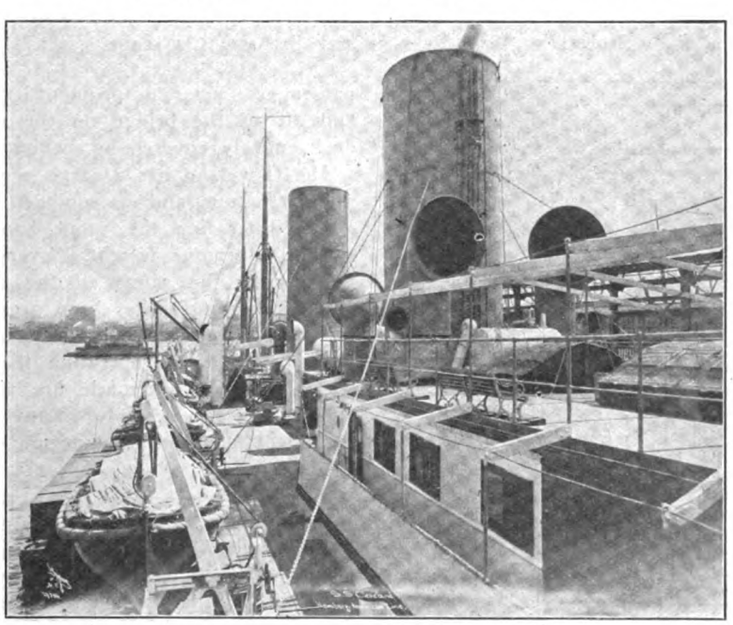


THE HAMBURG-AMERICAN LINER CLEVELAND.

ated by a battery of six boilers, three of which are double-ended and three single-ended. Three of her four dynamos are installed in the regular dynamo room, the fourth being situated on the upper deck. The Cleveland is lit throughout by 2,500 electric lamps, and is elaborately fitted with electric power. She has the usual auxiliaries in the way of pumping and other machinery, evaporating and distilling apparatus.

The double bottom extends the entire length of the ship. There are five decks to the Cleveland, which is built to the hurricane-deck-type, having no forecastle or poop. The hull is sub-divided into 11 watertight compartments. The first cabin passengers' accommodations are situated amidships and extend over four decks, namely, the saloon, upper, bridge and promenade. A large number of the rooms allotted to the second cabin passengers are also located amidships, while those of the third class are principally in the forward end of the vessel. Fourth class, or steerage, passengers are berthed on the lower 'tween and saloon decks, in accordance with German law. Altogether the Cleveland has accommodations for 300 first-class, 392 second-class, 494 third-class and 2,064 steerage passengers or a total of 3,250. With a crew of 360 men the total number of persons carried will be over 3,600.



VIEW OF UPPER DECK OF HAMBURG-AMERICAN LINER CLEVELAND, SHOWING BOATS ON WELIN QUADRANT DAVITS.

There are several features about the new vessel well worthy of mention, although they appeal particularly to the intending passenger. The recent introduction of an a la carte service on the various Hamburg-American Line steamers, and its accompanying success, has led the company to install a similar service on the Cleveland and Cincinnati, so that passengers may sit at the small tables in the first class dining saloon and order eatables at any time. A dark room for the use of photographers is another innovation, passengers having the privilege of the room for developing and printing. Here, also, the ship's photographer fills

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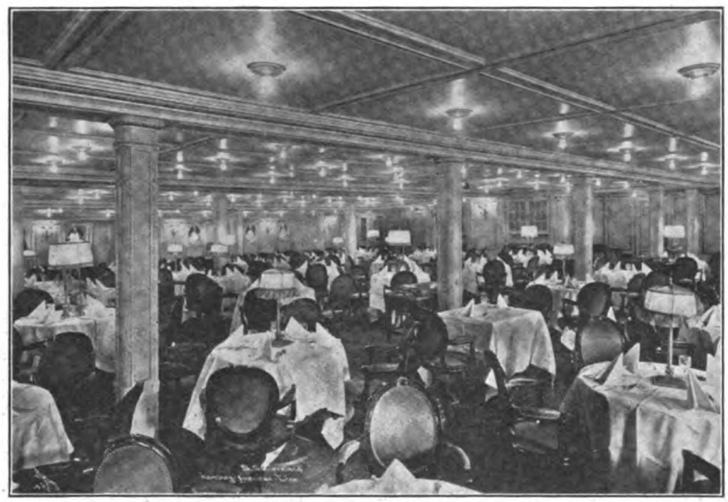
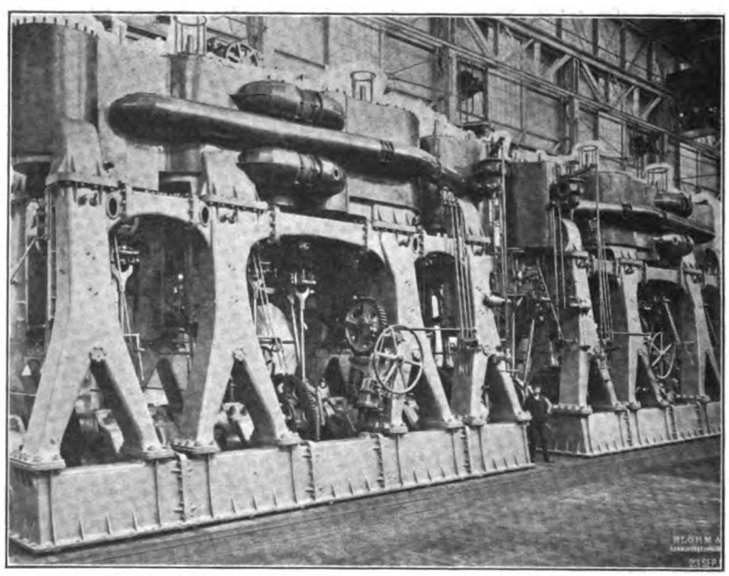


DINING ROOM OF THE HAMBURG-AMERICAN LINER CLEVELAND.

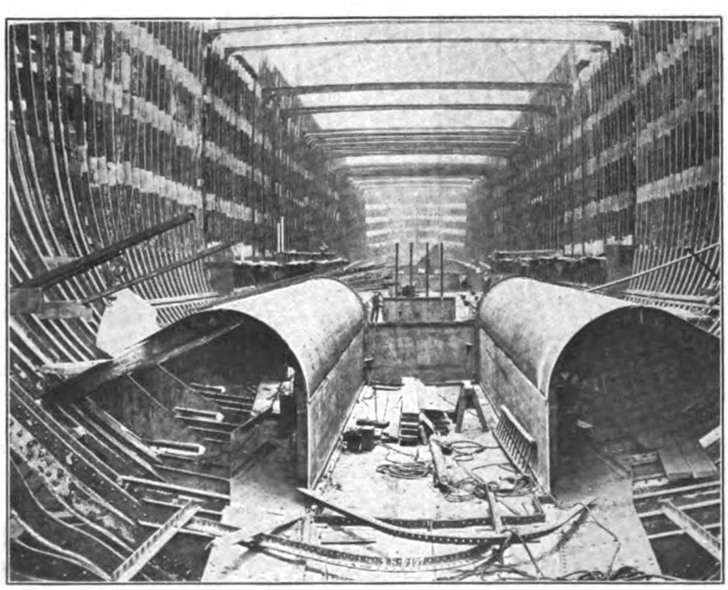
the passengers' contracts. The first cabin section of the Cleveland also includes a book stall, library, information bureau and gymnasium.

A notable feature of the first cabin accommodations is the large number of rooms with bath and toilet, and for the sole use of one passenger. The dining room on the upper deck is equipped with small tables, seating two, four or six persons each. A spacious lounge where the passengers can gather during inclement weather is unique in that the men have the privilege of smoking. There is a music room and writing room on the upper deck. The accommodations for second class passengers are also unusually elaborate and include a dining room seating 210 passengers, ladies' room, upper and lower smoking rooms, all the second class public rooms, with the exception of the dining room, having large square windows in brass frames, insuring plenty of light and fresh air.

Eleven compartments on the lower 'tween and saloon decks are fitted to accommodate the 2,054 passengers of the fourth class, or steerage, all the compartments being equipped with its quota of tables and seats and cupboards. The wash houses and toilet rooms are on the upper deck, as are also a large number of shower and other baths. Rooms for two, four and six passengers are provided for the accommodation of third class passengers in the forward part of the vessel. Here, also, is a large dining saloon seating 234 persons at one time. The third class passengers have a promenade fore and aft of the bridge on the upper deck entirely covered by awnings.



PROPELLING MACHINERY OF THE STEAMER CLEVELAND.



THE HAMBURG-AMERICAN LINER CLEVELAND IN COURSE OF CONSTRUCTION.

The Cleveland has a cargo capacity of 15,000 tons and is equipped with all facilities for the rapid handling of her enormous freight. Every appliance for the safety of the vessel and its passengers has been provided, including wireless telegraph apparatus, hydraulic gear for operating the water-tight doors, automatic fire alarms and extinguishers, inter-communicating telephones and a submarine signal system.

The former lake steamer Minnie E. Kelton, which has been ashore at the mouth of the Columbia river in Oregon since last May, has been floated through the efforts of Daniel Kern, of Portland, Ore., who bought the wreck from the underwriters for $1,400.

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STEEL AND NAVAL CONSTRUCTION.

(From the New York *Evening Post.*)

Mr. Asquith makes the somewhat cryptic announcement that "we may be on the eve of new developments and forms in naval construction which may vitally affect many of the governing conditions of naval strategy." This statement closely follows one made by Dr. Arnold, of Sheffield, that a new structural material has been developed which will revolutionize naval construction. Dr. Arnold is unsurpassed as an authority on the new developments in steel. In fact, to him belongs the honor of directing the manufacture of the first vanadium steel armor-plate which was made and tested by the Armstrong-Whitworth Co. in the spring of 1902. The result was a report that the vanadium steel-plate possessed a resistance to projectiles equal to that of existing armor-plates to double the thickness.

In asking how structural developments may affect battleships, we must remember that the displacement of the vessel herself is the actual total weight; and discussion about the power of vessels of the same total weight turns upon the distribution of the portions devoted to the elements of speed, endurance, gun-power, and armored protection. When the "wooden walls of England" were still her pride and sail-power still dominated, of the total weight of a vessel of war, fully 50 per cent was necessary for the hull alone to insure the strength necessary for sea-service. The introduction of iron reduced this amount to 45 per cent, and with all the improvements made possible within the past 20 years this weight of hull alone can scarcely be reduced below 40 per cent; while, in so far as structural improvements are concerned, no matter how great may be the improvement in the material itself, but an insignificant saving remains possible.

The Question of Displacement.

Both speed and endurance demand fuel, and fuel absorbs 10 per cent of the displacement. In armament, a different kind of obstacle is met. There can be no saving in weight in a projectile of any given calibre, because the value of the projectile itself is directly dependent on its weight. If we turn to the gun itself, the same trouble is met. Weight enables the mount and the fastenings to restrain the gun. Nothing connected with structural improvement can be gained in the weight of crew and stores, and these absorb 3 per cent. No improvement of structural consequence can be looked for in the weight of engines and boilers, for whatever saving could be made would at once be devoted to the element of speed; and in this element fully 12 per cent of the displacement is absorbed.

The only element remaining is that of armor, and there is but about 20 per cent of the displacement upon which Mr. Asquith can count to "vitally affect many of the governing conditions of naval strategy." Assume that what Dr. Arnold thought possible in 1902 has at last become a reality, and that, for a given resistance, armor-plates of one-half the thickness are procurable. The saving would be equivalent to 10 per cent of the total displacement. In the Neptune, laid down at 20,000 tons, a structural improvement equivalent to 2,000 tons might be effected, or, in other words, an original Dreadnought could be produced that would have all the advantages of the Neptune. But since in the latter vessel there is no alteration in battery power, the gain would only be applicable to speed.

Turn now to the type hitherto known as the armored cruiser, but which now is changing its name in Great Britain alone, and changing solely on account of structural developments, to that of battleship cruiser. We find in the Indefatigueable, the latest of these ships laid down, a decided increase of displacement over former vessels. In fact her displacement is the same as that of the Dreadnought, while her speed is rated at 28 knots, with confident expectations that she will make 30 knots. It seems therefore, at least plausible that the reference of the prime minister was to those improvements which are gradually merging the battleship and the armored cruiser into a single type.

Improvement in Steel for Naval Use.

What has been the course of improvement in steel as applicable to naval use? Nickel steel in France was by no means the origin of the new departure itself, as in other branches of mechanical development, the improvements due to adding tungsten, chromium and other prominent elements were known, although the causes were but ill defined. A method of cementation or baking carbon into steel, known as the Harvey process, displaced the nickel-steel plate, but scarcely had it become genrally introduced when what is known as the Krupp process, and which involved the use of chromium in connection with nickel, displaced the Harvey. The excellence of vanadium had been known since 1830. Only slight use, however, had been made of it on account of its scarcity and the cost of recovering it from ores in any condition for use. In 1902, the Armstrong-Whitworth Co. made and tried a nickel-chrome-steel plate, presumably in an attempt to surpass the Krupp plates, substituting vanadium for chromium. Meanwhile, the subject had been seriously taken up in France, but not as an armor question. The sudden development of the automobile, with its demands for increased strength and toughness of metal, gave a great impetus to laboratory work in that country, so that the intimate secrets of all the compound steels were soon familiar to French manufacturers and were closely followed in England and Germany. In the United States, rapid and secure progress along this line was mainly confined to the perfection of tool steels.

It is not necessary to go further into the details of the development of the many steel alloys. The metal vanadium now finds a place in all of them, and its attributes are commonly known throughout the steel manufacturing world. Whether in the actual structural application of the alloys to naval work, England is in advance of Germany, is unknown, but both are certainly in advance of the rest of the world. So far as Mr. Asquith's assertion is concerned, however little in evidence the application may appear in the United States, France, Japan or Italy, the methods and requirements are well known, so that, precisely as in the case of the all-big-gun battleship, the moment that actual construction threatens the "governing conditions of naval strategy," whatever they may be, other nations will respond at once.

A Japanese naval training squadron consisting of the protected cruiser Soya and the armored cruiser Aso sailed recently from Yokohama for Honolulu carrying 180 cadets of the Japanese navy. The squadron is due to arrive at Honolulu shortly and is then to proceed to San Francisco, later proceeding up the coast to Seattle. The two vessels were formerly Russian cruisers which were sunk by the Japanese during the war and which have been floated and added to the Japanese navy.

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A New Steamer for the Sugar Trade.

BUT A short while ago proceeded to sea on her first voyage from the yard of her builders — Sir Raylton Dixon & Co., Ltd., of Middlesbrough, England — a large, handsome steamer of over 7,000 tons deadweight carrying capacity, very specially designed for the sugar trade.

She has been built for the Colonial Sugar Refining Co., Ltd., of Sydney, New South Wales, which company has practically the monopoly of the sugar trade for the whole of Australia, and also owns enormous areas of sugar cane fields and crushing mills in the Fijian Islands.

This vessel named Fiona is built by Sir Raylton Dixon & Co., Ltd., on their well known Harroway & Dixon patent system of cantilever construction with top-side tanks. In this case the greater part of these will be utilized for the carriage of molasses in bulk, which will be pumped out by very specially designed pumps and delivered by means of fixed pipes on shore to large tanks situated some hundreds of feet distant by means of a compressed air service, actuated by a special engine on board the vessel.

The enormous holds, clear of any obstructions, such as beams, pillars, stringers or web frames with hatchways 30 ft. wide and 42 ft. long, will be most suitably adapted in the self-trimming feature to the carriage of coal from Sydney to the sugar factories in Fiji, and for return with sugar in bags or in bulk.

Her leading dimensions are 373 ft. x 52 ft. 4 in. moulded and she has a measurement cargo capacity of over 10,400 tons and will carry a deadweight of over three times her net register tonnage.

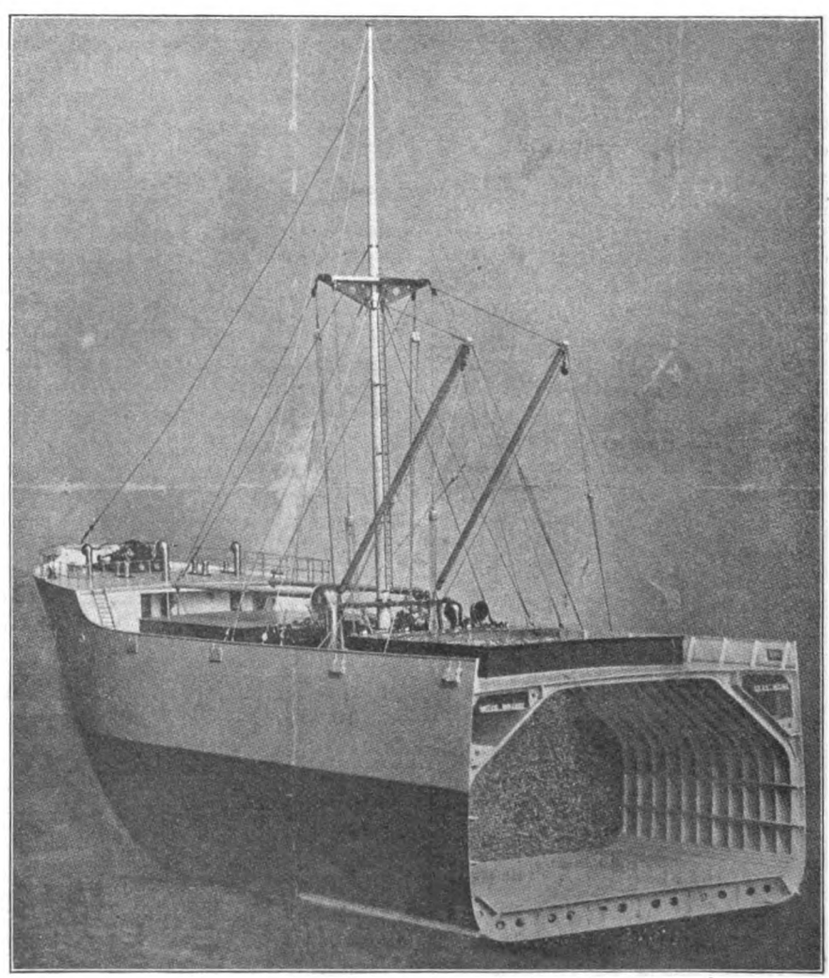
A large steel house is fitted amidships containing dining saloon, and staterooms, officers' accommodation with captain's cabin above and navigating room on top of latter. The engineers are accommodated in cabins at sides of engine casing while the firemen are berthed in poop tween deck aft and crew in forecastle.

In the poop tween deck is another large steel house containing the air compressor. In this room a special feature is introduced by the fitting up of Dr. Harker's patent fire extinguisher and fumigator, this vessel being the first on which the machine has been installed. Extensive trials on land have proved this apparatus to be most efficient and its introduction on board ship is looked forward to with considerable interest. The common method of extinguishing a fire aboard a steamer is by the use of steam or by flooding the compartment affected, thus damaging the contents, while the Harker system abolishes all risk of damage to cargo by an ingenious arrangement of collecting the flue gas from the funnel, cooling and cleaning same, then forcing it under considerable pressure through pipes into the desired compartment thus extinguishing the fire. The machine can also be used to disinfect the vessel and to destroy rodents and in addition can be utilized for the pumping of air throughout the ship.

The vessel has unique facilities for loading and discharging her cargo, being equipped with 3 masts, 10 derricks, 8 gaffs, 10 powerful steam winches with frictional ends by Clarke, Chapman & Co., with McFarland's patent clutches specially designed for rapid and economical working. She has also 6 watertight bulkheads, 4 boats, lifeboats fitted with Welin's patent lowering gear, electric light throughout including powerful searchlights, large refrigerating and cooling rooms aft.

She has been fitted with engines, placed aft, by Messrs. North Eastern Marine Engineering Co., Ltd., of Sunderland, having cylinders 25, 42 and 70 by 48 stroke, supplied with steam by 3 large single ended boilers working at 180 lbs. pressure.

The Imperial International Exhibition will be held in London during the present year upon the same site and under the same patronage as the Franko-British Exhibition, which has just closed. The attention of the engineering profession of the United States is especially directed to this exhibition.



PHOTOGRAPH OF A MODEL OF THE FORWARD SECTION OF THE FIONA.

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Experimental Tank for National Physical Laboratory.

AT A meeting of the council of the Institution of Naval Artects, held on April 2, 1908, the following letter was read from A. F. Yarrow, vice-president, intimating his readiness, subject to certain conditions, to defray the cost of an experimental tank to be established in connection with the National Physical Laboratory at Bushy, England. The proposed tank was to be primarily devoted to research work in problems connected with ship propulsion, but was also to be made available, when possible, for conducting experimental investigations of a confidential character for private firms, suitable fees being charged for this work.

Letter from A. F. Yarrow.

April 1, 1908.

The Secretary of The Institution of Naval Architects, 5 Adelphi Terrace, Strand, W. C.:

My Dear Sir—It will be in your recollection that a proposal was made in 1901, at the Glasgow meeting of the Institution of Naval Architects, that an experimental tank, unconnected with any firm, should be established in this country and made available for the general advancement of British ship building and ship owning.

Since 1901 the value of model experiments has become more and more evident, and one cannot help being much impressed with the fact that the ship owners and ship builders in this country, with a few isolated exceptions, are unable, without going abroad, to obtain information of a character which a tank might be the means of supplying. There also can be little doubt that if the tank were placed at the National Physical Laboratory, as formerly proposed, and largely devoted to research work, it would prove of great value in indicating the direction for possible advances in naval architecture. Having the above in view, I am prepared to present such a tank, provided:

(1) That one of the most modern character can be established for a sum not exceeding £20,000, and that it is established at the National Physical Laboratory.

(2) That suitable provision be made both as regards staff and means for conducting research work, as well as for experimental investigations of a confidential character which private firms may desire and for which they would pay suitable fees.

(3) That a sufficient sum be provided to ensure the tank being efficiently carried on for a period of not less than 10 years. This provision might take either the form of an endowment or of guaranteed subscriptions from ship builders and ship owners. I believe that an adequate provision for maintenance would involve not less than £2,000 a year; that is to say, a total guarantee fund of £20,000 would be required to maintain the efficient working of the tank for the above period.

Should this proposal be entertained by the council of the Institution, I would suggest that a small committee be appointed to study the practicability of the scheme. I remain, Dear Sir,

Yours very truly,

(Signed) A. F. YARROW.

Mr. Yarrow's munificent offer was gratefully accepted by the council on behalf of the Institution, and a committee was formed to take the steps necessary to give effect to Mr. Yarrow's proposals. The committee was composed as follows: Rt. Hon. Earl Cawdor, president (ex-officio); Sir William H. White (chairman); Sir Philip Watts, Professor J. H. Biles, James Dixon, F. Elgar (since deceased), R. E. Froude, Dr. R. T. Glazebrook, W. J. Luke, W. E. Smith, C. B., Professor J. J. Welch, M. Sc., A. F. Yarrow, R. W. Dana, M. A. (secretary).

Subsequently it was decided to form a building sub-committee to deal with the structural questions that would arise, and the following were elected thereon: Sir William H. White, R. E. Froude, Dr. R. T. Glazebrook, W. J. Luke.

At the April 2, 1909, meeting of the Institution the committee reported that in response to the appeal made by the committee to the leading ship building and ship owning firms, the following promises of support have so far been received, the amount in each case being promised annually for 10 years:

	£
Messrs. John Brown & Co.	100
Messrs. Cammell, Laird & Co.	100
Messrs. Doxford & Sons	100
Messrs. Fairfield Shipbuilding Company	100
Messrs. Harland & Wolff	100
Messrs. Lloyd's Register Society	100
Messrs. Peninsular and Oriental Steamship Co.	100
Messrs. Swan, Hunter & Wigham Richardson, Ltd.	100
Messrs. Vickers, Sons & Maxim	100
Mr. James Dixon	50
Messrs. Hawthorn, Leslie & Co.	50
Messrs. Holzapfel's Compositions Co.	50
Messrs. Parsons Marine Steam Turbine Co.	50
Messrs. Scott & Co., Greenock	50
Messrs. Babcock & Wilcox	20
Messrs. David J. Dunlop & Co.	20
Messrs. Thornycroft & Co.	20
Messrs. White Star Line	20
Messrs. Suter, Hartmann & Co.	10
	£1,240

This amount, it will be seen, falls short of the total required, but it must be remembered that during the past year particularly unfavorable conditions have prevailed in the ship building and ship owning industries, and this has militated against raising funds from these sources, notwithstanding many assurances of sympathy with the object in view. Moreover, the first year or two of the working of the tank are unlikely to call for their full share of the cost of maintenance.

Taking these facts into consideration, the governing body of the National Physical Laboratory, who were approached by the committee, agreed that in view of the importance of avoiding delay in the completion of the scheme, the executive committee of the National Physical Laboratory would become responsible for any deficiency that might be temporarily incurred in working and maintaining the tank in accordance with the donor's wishes. Mr. Yarrow has expressed his willingness to concur in this arrangement, and it is intended, therefore, to proceed as soon as possible with the execution of the scheme. It is most important, however, that the full amount of £2,000 a year should be guaranteed eventually, and it is anticipated that this result will be attained at an early date.

As regards the management of the tank, it is proposed that there should be an advisory committee, appointed by the governing body of the National Physical Laboratory, consisting mainly of representatives of the Institution of Naval Architects, who would draw up a definite scheme for the future working of the tank, advise as to the problems to be taken up, and arrange for the publication of results. The tank would be worked as a department of the laboratory under the general direction of the director, but with a superintendent appointed by the executive committee on the nomination of the tank committee, or in some similar manner.

The scheme drawn up by the committee would also settle what the staff of the department should be, and would indicate generally how the funds available for the maintenance of the tank and its work were to be expended. It would also provide for the maintenance of the confidential character of all work done at the tank for private firms, and would specify the conditions under which such work could be undertaken, and indicate the principles on which fees were

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DETAILS OF EXPERIMENTAL TANKS.

	Effective Length.	Depth of Water.	Breadth of Water.	Area of Cross Section.	Breadth of Building.	Breadth of Carriage.	Weight of Carriage.	Velocity.	Horsepower on Carriage.
	Ft.	Ft.	Ft.	Sq. yds.	Ft.	Ft.	Tons.	Ft. per sec.	
Berlin	479	11.5	34.0	29.5	34.6	19.8	13.5	23	20
Uebigau	289	11.3	21.4	22.3	30.10	23	5.5	16.6	20
Paris	528	14.0	32.8	36.3	41	34	25	15.5	100
Haslar	400	9.0	20	20.3	28.9	22	1.25	16	18
Denny's	275	10	25.11	28	26	4	—	—	—
Clydebank	400	9.5	20	20	28	21	2	16.6	12
Bremerhaven	476	10.5	19.8	22	26.3	20.6	—	15.6	20
Japan	450	12	20	26.6	—	—	—	20	30
Washington	384	14.75	44.6	46.5	47.6	45	32	30	200
Michigan	300	10	22	23.3	—	—	—	13.3	—
Suggested tank for the N. P. L.	500	12.5	30	40	42	31	10	25	50

The effective length means the length at the full depth, and does not include the docks or the sloping beach at the end.

charged. In general the scheme would provide that the council of the Institution of Naval Architects and the subscribers to the maintenance fund should have ample security that the tank was being worked in a manner consonant with the wishes of the donor.

In order to take advantage of any improvements that may have been introduced into the construction or equipment of experimental tanks in recent practice, Dr. Glazebrook, the director of the National Physical Laboratory, undertook, with the full concurrence of the committee, to visit the most recent establishments of the kind, both in the United Kingdom and also in France and Germany. Dr. Glazebrook's report upon the results of his visits is included in the second portion of the committee's report, and gives details of such features of the establishments visited as it appears desirable to introduce in the proposed installation. We have not space to do more than include the table of leading details of the tanks visited.

Lake Ship Yard Methods of Steel Ship Construction.

By Robert Curr.

Loading Vessels.

My observations in the loading of ships with ore have led me to think that the hopper type of vessel might be helpful to the captains in regulating and placing the cargo in the right place.

A load line could be run in on the hopper plating representing the height of the cargo as shown by Fig. 52.

It is not necesary to have any fine line only the line most desirable for loading which saves trimming the cargo. The object being to confine the weight to its own place and thus crediting the designer with creating something useful and lasting. The same thing would be beneficial to the structure in having the weights placed rightly and prolong the life of the ship.

Two lines might be run in representing the top and bottom of the dome formed by loading from the ore shoot, or the actual shape of the ore as it is run into the vessel, after the same has been figured out and found to be the actual weight of the water displaced.

In representing the owners in the supervision of construction of their ships, I, as a rule, made the first trip and noted all conditions until the vessel was loaded and had arrived at her first destination. It was stated that a steel vessel loaded would sag as much as 12 inches.

We put on level lines at the center and on the sides of the vessel while she was on the stocks but there was no perceptible change in the shape of the vessel during or after loading. My experience arond the ore docks was nearly always after dark.

The captains were governed by the ore in the pockets and regulated the loading by the number of cars in same. The captains went about this part of the work very intelligently and got along nicely until the trimming of the vessel came about. The aim is to have the vessel draw a few inches aft more than forward so that when she gets to her destination there will be so much fuel gone and she will arrive at her port on a level keel.

The trimming of the vessel took a long time, even longer than loading the vessel on a level line. A lamp was hung just over the water marks at the bow and stern and men were stationed there who notified the captain or mate what progress was made as the ore was run in from the shoot.

If it is stormy or a ripple on the lake it is impossible to get the desired trim.

If the load line were on the hopper plating then the work could be done quicker and to the right trim. Fig. 50 shows a midship section, Fig. 51 a vessel floating at her 20 ft. water line and Fig. 52 the half of same vessel cut off at the 20-ft. water line. The load is shown on Fig. 52 as it ought to be so that the vessel will float on an even keel, both weight and buoyancy being nearly equal.

The following information may be of interest to the captains and at the same time useful:

If all the weights of the cargo were located on the vessel then all the captain would have to do would be to load to the marks but as he is not furnished with that information the following will perhaps help him to make his own marks.

The captain could furnish a lot of information to the naval architects if he took up the study of technical ship building. Theory and practice does not always agree so that it takes all those concerned to perfect practice and theory.

This vessel I am considering is of the hopper type as shown by the midship section, Fig. 50.

Length over stem and stern post on L. W. L., 504 ft. 0 in.; breadth inside of plating, 58 ft. 0 in.; depth inside of plating, 30 ft. 0 in.; draught from underside of plating, 20 ft. 0 in.; block coefficent, 0.978; midship area coefficient, 0.981; displacement, 15,986 tons; weight of hull, 3,500 tons; weight of cargo, 16 cu. ft. per ton; weight of machinery, 638 tons; center of buoyancy and gravity at center of ship.

The captain can soon find out what the vessel will carry and by arranging his block or coefficient of fineness he can arrive at the placing of his weights.

The shell plating weighs 6 tons to the 1,000 when the vessel is loaded to her load water mark. 15,986 — 96 = 15,890 tons = displacement measured from the inside of the plating.

This displacement (the molded displacement) divided by the sum of the

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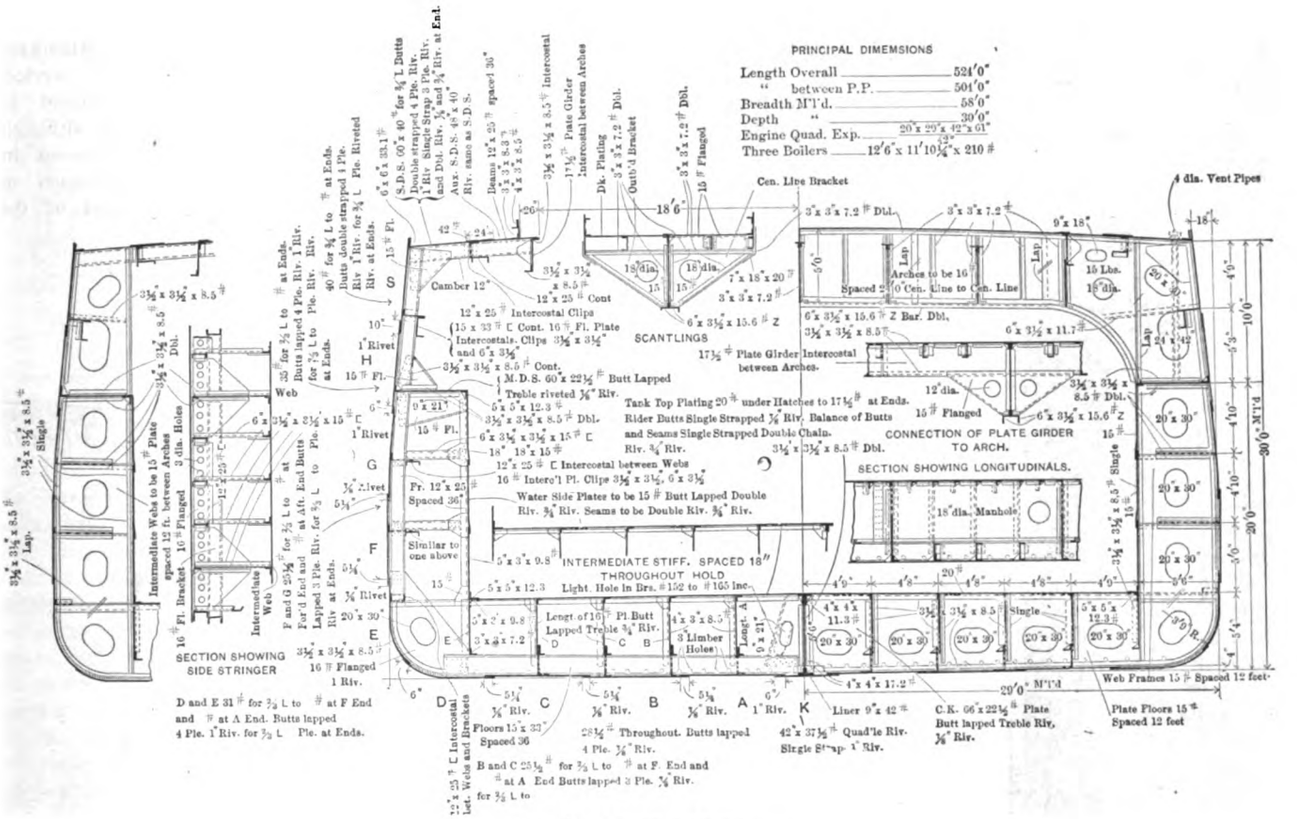
PRINCIPAL DIMENSIONS
Length Overall 524'0"
" between P.P. 501'0"
Breadth M'Td. 58'0"
Depth " 30'0"
Engine Quad. Exp. 20" x 29" x 42" x 61"
Three Boilers 12'6" x 11'10¼" x 210 #
SCANTLINGS
SECTION SHOWING SIDE STRINGER
SECTION SHOWING LONGITUDINALS.
CONNECTION OF PLATE GIRDER TO ARCH.
INTERMEDIATE STIFF. SPACED 18" THROUGHOUT HOLD
Cen. Line Bracket
4 dia. Vent Pipes
Tank Top Plating 20 # under Hatches to 17½ # at Ends.
18'dia. Manhole
Liner 9" x 42 #
Plate Floors 15 # Spaced 12 feet
Web Frames 15 # Spaced 12 feet

FIG. 50—MIDSHIP SECTION.

length, breadth and draught divided by 36 will give the block coefficient.

$$\text{Example: } \frac{15{,}890}{504 \times 58 \times 20 \div 36 = 0.978}$$

A b, Fig. 52, represents the length of the vessel of the same dimensions or "dead flat."

This length is 201.6 ft. long.

The width is 58 ft. and draught 20 ft.

There are 36 cu. ft. of fresh water to the ton so that

$$\frac{201.6 \times 58 \times 20 \times 0.978 = 6{,}356 \text{ tons.}}{36}$$

The weight of the hull equals 22 per cent of the displacement so that 22 per cent of 6,356 = 1,398 tons. 6,356 — 1.398 = 4,958 tons of cargo.

By placing the same amount of cargo in this length of the vessel the weight and water pressure are equal.

The cargo space is rectangular so that no coefficient is required in this case.

$$\frac{201.6 \times 47 \times 8.372 = 4{,}958 \text{ tons.}}{16}$$

The height of the ore is 8.372 ft. above the tank for this length.

The cargo and steel in hull equals 6,356 tons and for this length of the vessel the ship may be considered at rest.

The ends in this case are considered the same and when the middle part is removed leaves $\frac{201.6}{2} = 100.8$ ft. at fore and after ends.

The cargo space does not have that length so that the cargo must be stowed in a way not to injure the structure.

Cargo space left is 63.2 ft. aft and 84 ft. forward.

	Tons.
The displacement amounts to..	15,960
Steel and machinery.....	4,138
Cargo	11,822

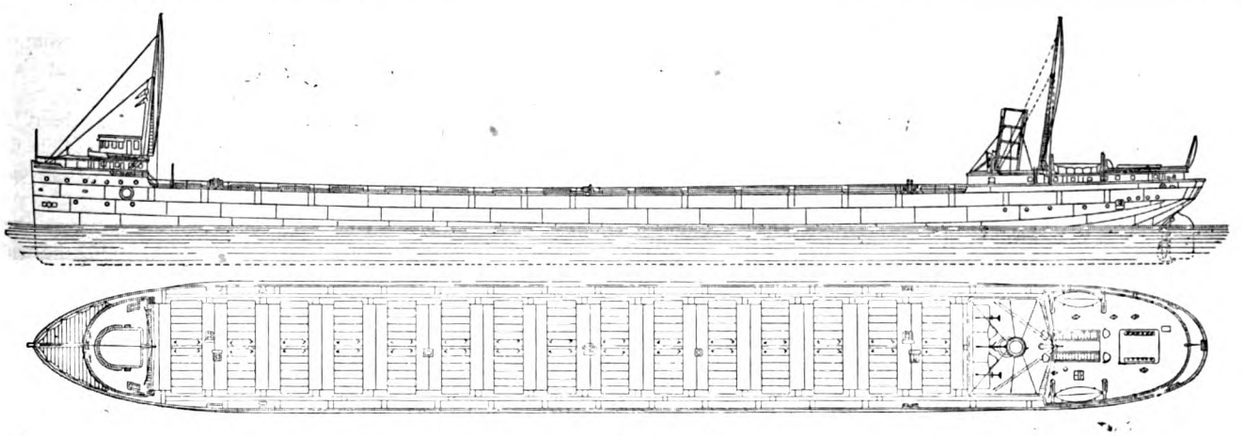

FIG. 51—OUTBOARD PLAN ABOVE THE 20-FOOT WATER-LINE AND SPAR DECK.

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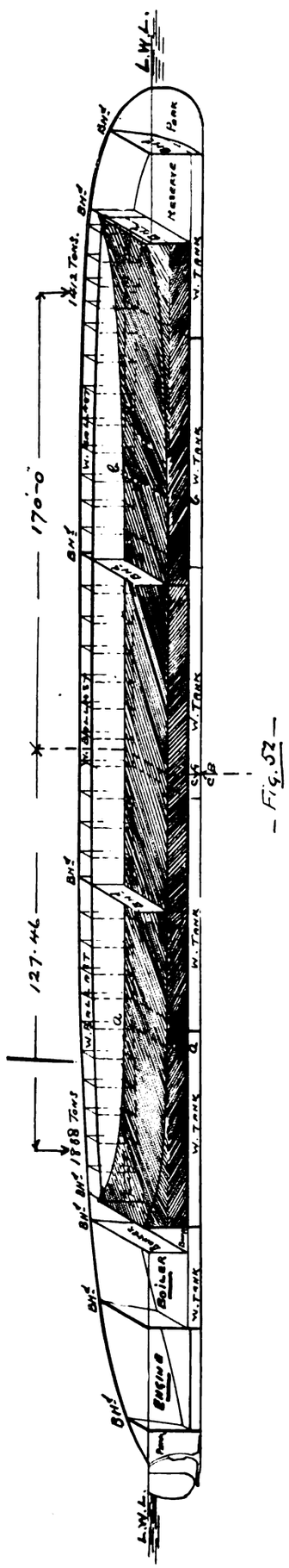

11,822 — 4,958 = 6,864 tons to be placed in the ends. $\frac{6,864}{2}$ = 3,432 tons.

By following the line of the ore amidships 8.372 ft. above the tank top to the end it amounts to $\frac{47 + 46.4}{2}$ = 46.7 sq. ft. mean area of cross section aft.

$$46.7 \times 63.2 \times 8.372 = 1,544 \text{ tons.}$$

$$\frac{}{16}$$

3,432 — 1,544 = 1,888 tons of excessive weight in this vicinity and equal to the excessive buoyancy beyond the cargo space.

Forward under the same conditions as aft area of cross section equals:

$$47 + 44.8 = 45.9$$

$$\div \quad 2$$

$$45.9 \times 84 \times 8.372 = 2,020 \text{ tons}$$

$$\frac{}{16}$$

3,432 — 2,020 = 1,412 excessive weight over buoyancy and equal to the excessive buoyancy beyond the cargo space.

This cargo must be placed in the vessel so that she will float on a level keel and draw 20 ft. of water. Fig. 52 shows the cargo 1,888 tons placed aft 127.46 ft. from the center of gravity and equal to 204,040 ft. tons.

Forward 1,412 tons is placed 170 ft. before the center of gravity, giving the same 204,040 ft. tons which is necessary to float the vessel on an even keel.

In this arrangement the cargo is placed as far forward and aft as possible compensating for the excessive buoyancy beyond the cargo space.

There is an excessive weight at this point (170 ft. forward and 127.46 aft.) but it will be less harmful to the structure than if it were placed in the middle.

The fuel used between the loading point and home port is not considered in this calculation.

When the vessel is loaded it will draw more water aft, owing to the fuel being aboard, but be on a level keel when at destination if so desired.

NEW STEAMER E. G. CROSBY.

The steamer Naomi, which burned on Lake Michigan last year, is being completely rebuilt by the Manitowoc Dry Dock Co., Manitowoc, Wis., for the Crosby Transportation Co., of Milwaukee. The Naomi, which was built in 1881 by the Detroit Dry Dock Co. at Wyandotte, Mich., and was called the Wisconsin, was one of two iron sister ships built for the Detroit, Grand Haven & Milwaukee Railroad. The second of the pair, the Michigan, was lost after a very short service, but the Wisconsin has continued in commission all the year round, although the name was changed to Naomi in 1895. The hull was not damaged in the fire which destroyed most of the

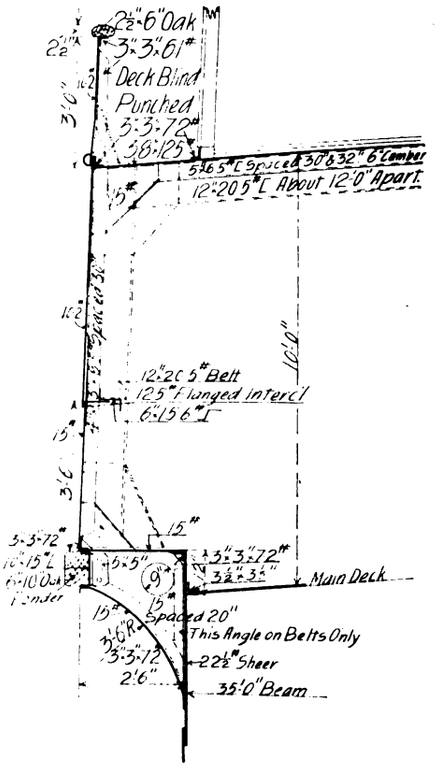

FIG. 2—SHOWING HOW ADDITIONAL DECK SPACE IS OBTAINED.

upper works, and so it is perfectly correct to say that, when reconstructed, the E. G. Crosby, as she will be known, will be a better ship than ever.

Fig. 1 shows the ship as she will appear with her new upper works. Fig. 2 shows an interesting detail of construction. In order to obtain more deck space a 2-ft., 6-in. guard has been worked and the brackets plated, which, with the heavy channel carrying the fender wales contribute great additional strength.

The steel construction has been carried up to and includes the cabin deck and the unusual height between decks is noticeable.

There are three decks, viz., main, cabin and upper deck. On the cabin deck there will be 54 staterooms and parlors, a number of which will be connecting. The upper deck will consist of 46 staterooms, in addition to pilot house, texas and captain's room. The passenger cabins and social halls will be finished in curly birch and will

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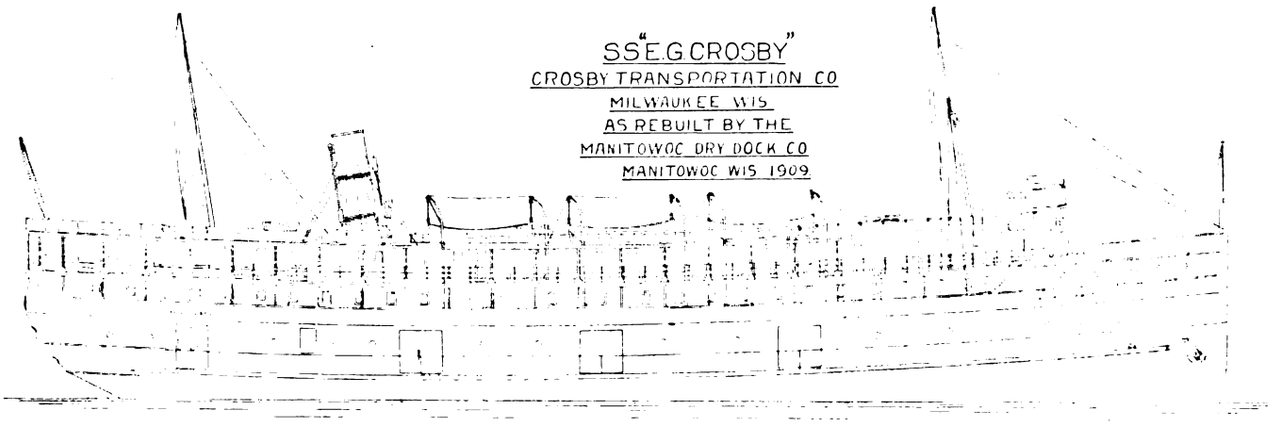

FIG. 1—THE E. G. CROSBY AS SHE WILL APPEAR WITH HER NEW UPPER WORKS.

be furnished to match. The staterooms will have every modern convenience, hot and cold water, open plumbing, electric call bells, and will be electric lighted.

On the main deck aft, will be located social hall, from which stairs will lead to upper cabin. In social hall will be purser's and steward's offices and rooms, also baggage and parcel room. On main deck forward will be galley, officers' mess room, smoking room and officers' quarters. Th deck crew will be housed forward below main deck.

The vessel is to have four gang ways, three of which are to be used for freight and one for passengers. The freight space will be separated from passenger space by means of steel deck above and steel bulwarks at either end. She will be equipped with steam steerer and windlass.

The vessel is to cost $200,000.00 and will have a passenger carrying capacity of 1,500 passengers and sleeping accommodations for 300 passengers, and will carry 1,200 tons of freight. She will be provided with the latest improved life boats, rafts and life saving appliances and will be equipped with wireless telegraphy.

The reconstruction plans have been approved by Nevins & Smith, of Chicago and Cleveland, who will also look after the work. The Crosby will be placed on the Grand Haven route between Milwaukee and Grand Haven, Mich., in connection with the Grand Trunk Railway System.

BOOK REVIEWS.

The Resistance and Propulsion of Ships. By William F. Durand. Second edition. John Wiley & Sons, New York. 6 x 9. 422 pages. Supplied by the MARINE REVIEW for $3.

The reason for issuing this work in its revised form is not apparent since the amount of new matter is comparatively small and consists chiefly of the results of Prof. Durand's experimental work with screw propellers which has been already very fully set forth in previous publications, and of some developments in hull design. The turbine is dismissed with scant reference to its influence either on hull or propeller design or on the general problem of propeling the ship. Engineers and naval architects will find little in this new work that is not already before them and will probably agree to differ as to the value of most of that, since it can scarcely be said that the new points covered are by any means demonstrated.

The Great Lakes—The Vessels that Plow Them, Their Owners, Their Sailors and Their Cargoes. By James Oliver Curwood. 227 pages, 6 x 9 in. 72 illustrations. G. B. Putnam's Sons. Price $3.50.

This work was published originally in serial form in *Putnam's* and the *Reader* under the title, "The Romance of the Great Lakes." The publisher has done his work well, as the letterpress is wholly creditable; but not so with the author. It is a poor thing, being inaccurate and superficial. When facts are so readily obtainable, it is unpardonable to err. The great lakes afford a vast theme for the intelligent historian but this work is merely bombast and twaddle. We repeat that it is a pity that the author should employ fiction when the truth is so readily obtainable. Consider this sentence concerning Harry Coulby, president and general manager of the Pittsburg Steamship Co.:

"There was a time when Coulby was a poor mechanic working his 10 hours a day; then he developed 'talent' and went into a ship yard drafting room. Now he is undeniably the king of lake shipping."

Had the author said that Mr. Coulby was a stenographer, that he assisted John Hay in writing his "Life of Lincoln," that through the offices of Hay he met Samuel Mather and entered the employ of Pickands, Mather & Co., eventually succeeding to membership in that firm and the operation of its docks and vessels, he would be nearer the truth. Mr. Coulby occupies the first position as an employer of labor on the lakes, but he reached that position through entirely natural processes.

Consider also this paragraph:

"How many of our millions have heard of J. C. Gilchrist and the Gilchrist fleet, a man in one way unique in the marine history of the world and a fleet which if plying between New York and Liverpool would be one of the present day sensations. Gilchrist, like Coulby, has 'worked up from the depths' and today as the head of the Gilchrist Transportation Co. he holds down 75 distinct jobs. Seventy-five owners have placed 75 ships under his generalship and from each he receives a salary of $1,000 a season, or a total of $75,000. He is one of the Napoleons of the lakes. He handles ships and men like a magician; his holds are never empty, his dividends are always large."

This paragraph must be alike surprising to Mr. Gilchrist and his stockholders. Recent developments in the affairs of this company make further comment unnecessary.

The author's tendency is to exaggerate. In his desire to do full justice to the American Ship Building Co. he increases its seven yards to 11, and then magnanimously pronounces the plant of the Great Lakes Engineering Works at Ecorse to be the greatest in America.

In his description of William Livingstone, president of the Lake Car-

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riers' Association, he makes this amusing remark: "He seldom speaks first." The author's experience in this particular has apparently been unusual. The common opinion is that William Livingstone speaks not only first, but last and all the time. The author doubtless has never heard the worthy president expounding briefly on one of his annual reports. Otherwise he is quite happy in his description of William Livingstone, who is one of the most courteous and accomplished of gentlemen and whose ideals of duty and devotion to them are of the highest.

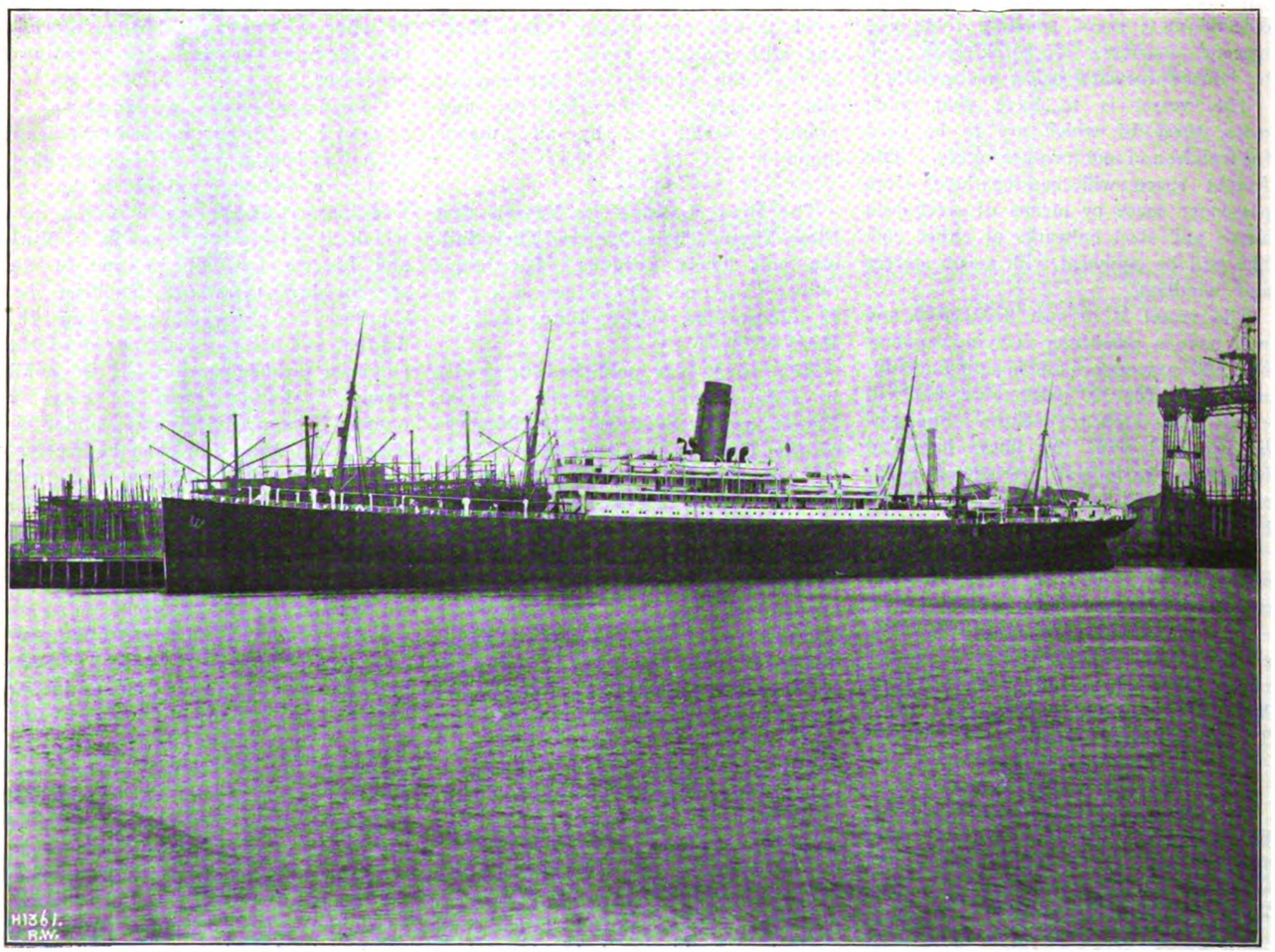
The author did well to go to William Livingstone for ideas on lake shipping, for he is as full of them as a watermelon is of seed. Doubtless many of the excellent comparisons in which the book abounds regarding the volume of lake commerce are Mr. Livingstone's. For instance, he says it would take a train of 40-ton freight cars encircling unbrokenly the globe to contain the commerce that is carried in the ships of the great lakes during the brief season of eight months. This is very good and it was probably William Livingstone who thought of it.

The chief merit of the book lies in the fact that it gives to the layman a good idea of what the commerce of the lakes really amounts to. The author's errors have been in trying to make things more wonderful than they are, not seeming to realize that the truth concerning the great lakes and their amazing development is stranger than fiction.

White Star Line Triple-Screw Steamer Laurentic.

NO LITTLE satisfaction was expressed by those engaged in the Canadian trans-Atlantic trade when it was officially announced early last year that two new steamers were under construction at the yards of Harland & Wolff, Belfast, for the intended White Star-Dominion Line service between Liverpool, Quebec and Montreal. With the arrival of the triple-screw steamer Laurentic at Montreal this month the first of the two vessels to be completed has formally taken her place in the service. Her sister ship, the Megentic, enters the service in June.

The Laurentic is the largest vessel in the Canadian trade, being 565 ft.



WHITE STAR LINER LAURENTIC, FITTED WITH COMBINATION TURBINES AND RECIPROCATING ENGINES.

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in length and of about 15,000 tons, and, in addition to large cargo carrying capacity, can accommodate about 1,700 passengers. She is of the highest type of modern construction, with double-bottom extending the full length of the vessel and numerous water-tight bulkheads. She has in addition to other equipment the latest and most improved Marconi system of wireless telegraphy and submarine signalling apparatus.

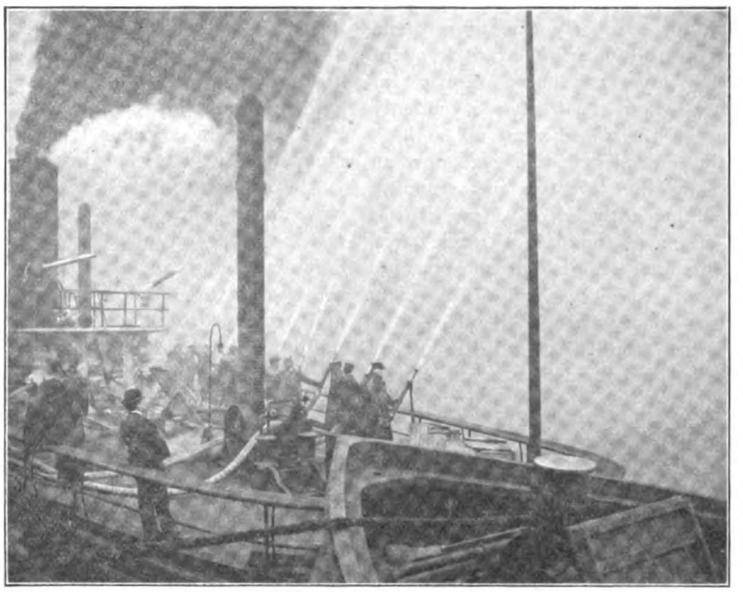
The arrangement of her propelling machinery is notable in that it consists of a combination of reciprocating engines with low pressure turbine, an entirely new departure in marine engineering, driving three propellers.

The first class dining saloon is situated on the saloon deck and has seating accommodation for 212 persons. The reading, lounging, smoking and other first class public rooms are situated on the upper promenade deck. The second class saloon is on the middle deck, extends the whole width of the vessel and seats 264 persons. The smoking room is on the upper promenade deck, while the library and other rooms are situated on the lower. The third class dining room is on the upper deck aft. The furnishings are unusually handsome throughout the vessel.

CHICAGO FIRE BOATS.

The new fire boats Joseph Medill and Graeme Stewart, built for the City of Chicago by the Manitowoc Dry Dock Co. from the designs of Mr. W. I. Babcock, engineer and naval architect, of New York, have finally been completed and gone into service and have demonstrated, at two or three large fires on the river bank, notably at the burning of the Illinois Central elevator recently, what very successful fire fighting machines they are. Considerable criticism of the boats has been heard, however, and it must be admitted that much of it has been justifiable up to a late date, for one of the first requisites in a fire boat is reliability in service and since last fall there has been a constant series of break downs and accidents on both boats.

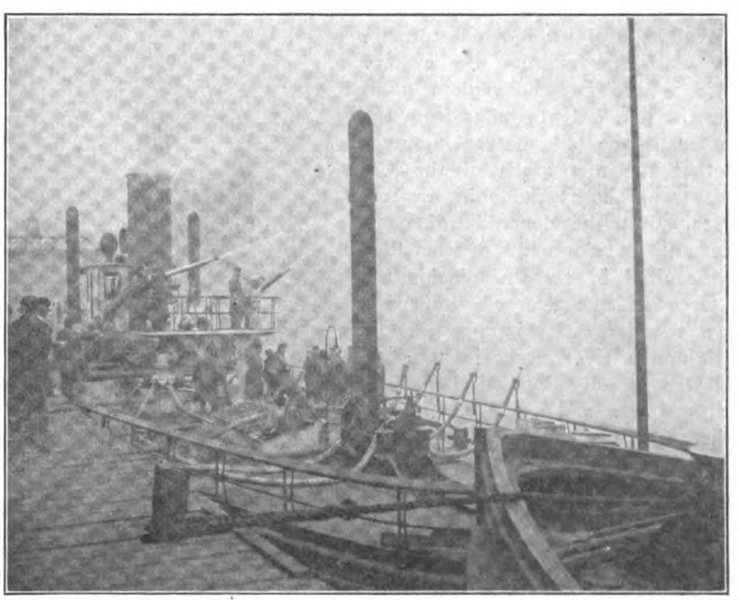
The general impression, however, that this has been because of the fact that the boats were electrically propelled, and that all their troubles have been due to the electric propulsion, which was an experiment which therefore should never have been tried, is entirely erroneous. As a matter of fact, the electric propulsion has been



CHICAGO FIRE BOAT IN ACTION.

a great success from the start, has never given the slightest trouble or delayed the boats in any way whatever, and the handling of the boats from the pilot house with the motor-driven twin screws has been perfect and exceeded all expectations. That a generator in one boat did break down at one time does not affect this statement, as the accident meant no more than would the breaking of a shaft in an ordinary engine, which is liable to happen at any time.

As is well known, the boats are operated by Curtis condensing turbines, which drive both the centrifugal fire pumps and the electric generators which furnish the current to the motors driving the twin screws. Both in the design and construction of this machinery the General Electric Co. have been, to say the least of it, extremely careless. It is evident that everything depends on the continuous operation of the turbines when once started, for any stoppage, no matter how brief, stops either the motors or the pumps, whichever are in service at the time. These turbines run at a high speed, 1,800 R. P. M., and, when operating the motors, the whole load may be thrown off or on instantly. These conditions are common enough in such apparatus and should have given no trouble whatever, yet no sufficient provision was made, in either



CHICAGO FIRE BOAT IN ACTION.

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the oiling arrangements or the governors, for properly meeting them. Stops from hot bearings were frequent and the governors were utterly inadequate—when the load was suddenly thrown off the speed went up so high that the emergency trip was thrown in, closing the throttle, and stopping the machine entirely. Bad mechanical work was also found in various parts, with the final result that one turbine rotor went to pieces under the strain and was badly wrecked. This one had to be rebuilt and all the others overhauled and lined up as well. Then the original ball governors were thrown away and hydraulic governors of the latest type fitted, and the oiling arrangements were completely remodeled, new oil pumps with a positive mechanical drive from the turbine shaft itself being installed.

All of this took a lot of time, but the final result has been entirely satisfactory, and now the boats have demonstrated conclusively that they are ready for service at any instant and are able to steadily deliver 10,000 gallons of water a minute, at 150 lbs. pressure, just as long as there is a pound of coal left in the bunkers to keep up steam. In this they stand absolutely alone among the fire boats of the world, excepting two in New York and one just finished for the Mesaba Rail Road at Duluth, which have the same type of turbines and centrifugal pumps. All other fire boats in existence, with reciprocating non-condensing pumps, use so much steam that it is impossible to get boilers enough in the boat to supply it, consequently, for any steady service, they can deliver not much more than half their rated capacity in water pumped.

The Harbor of Portland, Oregon.[1]

An Excellent Example of the Beneficial Effects of the Efficient Municipal Improvement of an Inland Waterway--- A City that Operates Dry Dock and Dredges.

By H. Cole Estep.

IN THIS series of articles describing the principal harbors of the north Pacific coast, it is logical to begin with the Columbia river, which is the oldest, in some respects the most famous, and in many ways the most unique harbor on the western seaboard. Some years before Puget Sound was known to anything but Indian dugouts and an occasional trading ship and nearly half a century previous to the gold discoveries that made the Golden Gate a household word throughout America, the Columbia river had been made the focus of national attention through the memorable expedition of Lewis and Clarke and the daring colonization exploits of John Jacob Astor.

Mr. Astor, in founding the city of Astoria at the first convenient point within the bar, only 14 miles from the ocean, made the only natural assumption that the metropolis of the Columbia would be at the point nearest the sea. But the demands of commerce and development of the "Inland Empire" in eastern Washington and Oregon have decreed otherwise. Today the largest shipping port in the Columbia river basin is at Portland, Ore., a city located 114 miles from the ocean and not even situated on the Columbia river but on one of its tributaries, the Willamette. The disadvantages due to the interior location of Portland harbor have been in a large measure overcome through the activity of the citizens expressed in their corporate organization, the Port of Portland. This unique organization has such a large share in the development of Portland harbor that we will examine it in detail later in this article.

Geographical Location of Portland.

Portland by water is 114 miles southeast of the Pacific ocean. Of this distance 102 miles is on the Columbia river and 12 miles on the Willamette river. The mouth of the Columbia is a wide estuary guarded at the entrance by a bar which is exceedingly rough and troublesome in bad weather but which at most times can be safely and easily navigated with the aid of a pilot. Except during the spring freshets the lower river is rather sluggish and is subject to tidal fluctuations as far up as Portland and Vancouver.

At low water seasons the minimum natural depth of the Columbia river between Portland and the sea is about 12 feet, but through the efforts of the Port of Portland, working in conjunction with the United States engineers, a channel with a minimum depth of 25 feet at low water and a minimum width of 200 feet is maintained at all times. Vessels of the largest draught operating on the Pacific coast are therefore able to pass freely to and from Portland without delay and with no necessity for lightering. A project is now under way for the maintenance of a 30-foot channel. The channel, as is seen from the accompanying map, Fig. 1, is quite straight and has no short, sharp turns; the channel is also well buoyed, lighted, provided with ranges and equipped with fog signals, making it safe for navigation at all times.

All the Year Navigation.

The river is open for navigation throughout the entire year and because of the mild climate delays or dangers to traffic on account of ice are of such rare occurrence as to be practically negligible. Zero weather is unknown in the Columbia river valley. The port charges are therefore the same throughout the year and not higher in the winter as is the case with a number of Atlantic coast ports, notably New York.

All vessels require the services of a pilot in crossing the bar. Sailing vessels must be towed between Portland and the sea, but do not require river pilots, the tug masters performing this duty. Most steam vessels employ river pilots between Astoria and Portland. Steamers can navigate and maneuver in the channel without the assistance of tugs. The Oregon bar pilot rates are $5 per foot of draught and 2 cents per registered ton for taking a ship over the bar in either direction; a 2,000-ton ship, drawing 15 feet, would pay $115 each way for bar pilotage. The river pilot charges are $2 per foot of draught and 2 cents per registered ton measurement. The bar pilot charges are

[1]First of a series of articles describing successively the harbors of Portland, Seattle, Tacoma, Vancouver and Victoria.

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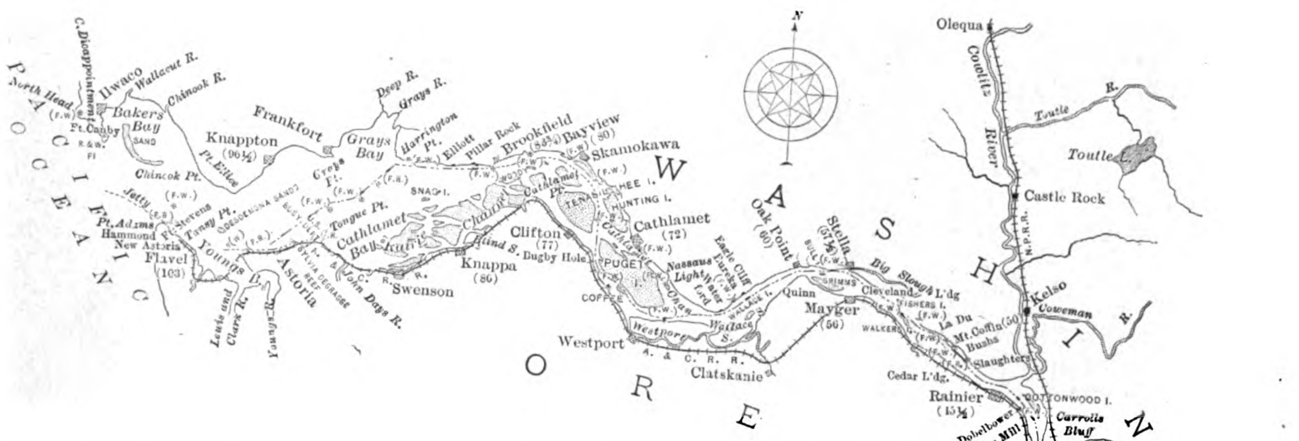

FIG. 1—MAP OF PORTLAND AND ADJACENT WATERWAYS.

absorbed by the towing company in the case of sailing vessels entering the Columbia river and leaving loaded with grain or flour for European ports. The towing company does not absorb pilot charges of other vessels.

The towing is now done by the Port of Portland. The charges for the round trip between Portland and the sea vary from $500 for a 500-ton vessel to $850 for a 3,000-ton vessel. These rates include pilot charges for grain and flour ships as enumerated above, but not otherwise. The hawser charge is $15 each way. Lumber vessels receive a rate of 50 cents per 1,000 ft. B. M. and are not subjected to a hawser charge. The rate for an average cargo of 1,000,000 ft. is therefore $500.

Largest Grain Shipping Port.

Portland is the largest grain shipping port on the Pacific coast. The amount of shipping originating in this harbor is shown in the accompanying tables. Table I shows the commerce of Portland from 1898 to 1908, and Table II shows the tonnage across the Columbia river bar from 1887 to 1908. In the 20 years between 1887 and 1907 the commerce of the Columbia river has increased 330 per cent, or 16½ per cent per annum.

That this rapidly growing commerce has been kept in Portland in spite of the active competition of other Pacific coast cities in some respects more favorably situated, is due almost entirely to the work and efforts of the Port of Portland, an organization unique in American commercial affairs.

The Port of Portland is a municipal corporation chartered by the state of Oregon in 1891. Territorially it embraces all of the city of Portland and certain adjacent property in Multnomah county, Oregon, contiguous to the Willamette and Columbia rivers. The area of the port district is approximately 400 square miles. All the inhabitants of this district are members of the Port of Portland. The Port of Portland has authority to levy and collect taxes on all real and personal property within the port district; the rate of levy is fixed to not exceed 3/20 of 1 per cent, with authority to make special levies for specific purposes. The corporation is in no way connected with the city government of Portland or with any other local government; the corporation was not chartered for purposes of government but for carrying on the business of improving Portland harbor.

Improvement of the Harbor.

The corporation was created because the shallow channel in the Columbia river was such an inconvenience to shipping that Portland was in grave danger of losing its deep water commerce entirely. The appropriations of congress, spent under the direction of the United States engineers, while of great benefit in improving the river, were utterly inadequate to cope with the problem. The people of Portland, realizing that the river must be made easily navigable or the city would lose the greater portion of its prestige among the commercial towns of the Pacific northwest, organized the Port of Portland and endowed it with the primary duty of dredging a 25-ft. channel between Portland and the sea.

Gradually other needs for the harbor of Portland became evident and other duties have been assigned by the Port of Portland. A 10,000-ton floating dry dock was built, dykes and permanent improvements were made in the channel; finally steps were taken to operate the towing and pilot service between Portland and the sea and to provide for the free disposal of ballast. In short the Port of Portland makes it its business to see that the harbor of Portland has every advantage attractive to shipping. All the work undertaken is of an essentially public character and there is no interference with private prerogatives.

Portland's Dredging Operations.

Politics has nothing to do with the Port of Portland and the Port of Portland has nothing to do with politics. It is an efficient, business-like organization. The management of its affairs is in the hands of a commission of seven members. The commissioners are responsible business men, all citizens of Portland. They serve without compensation and hold office until released by death, resignation or change of residence. New commissioners are elected by the remaining members, thus creating a self-perpetuating body. Any member of the commission may, however, be removed by a referendum vote of the people. The commissioners elect a president, vice

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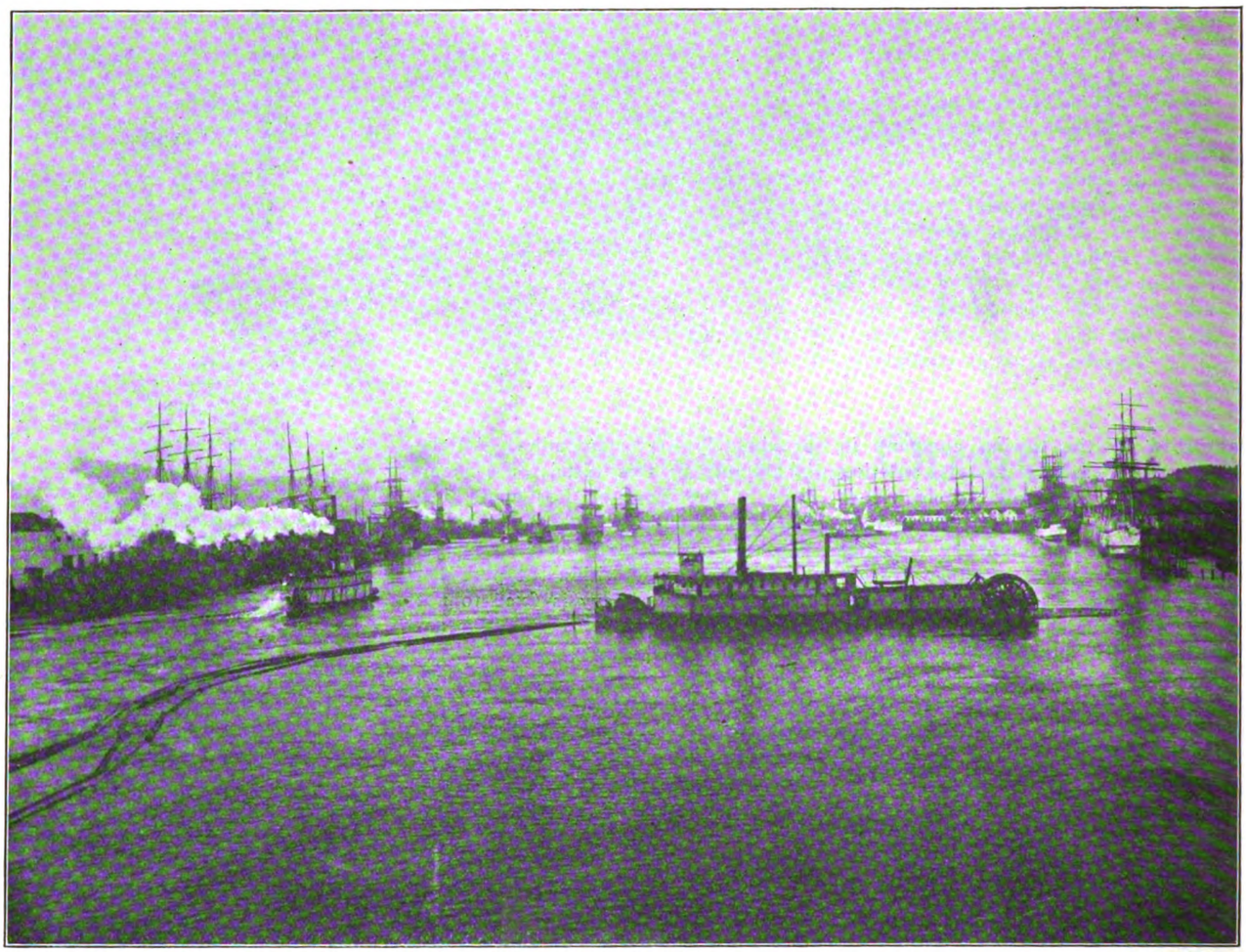
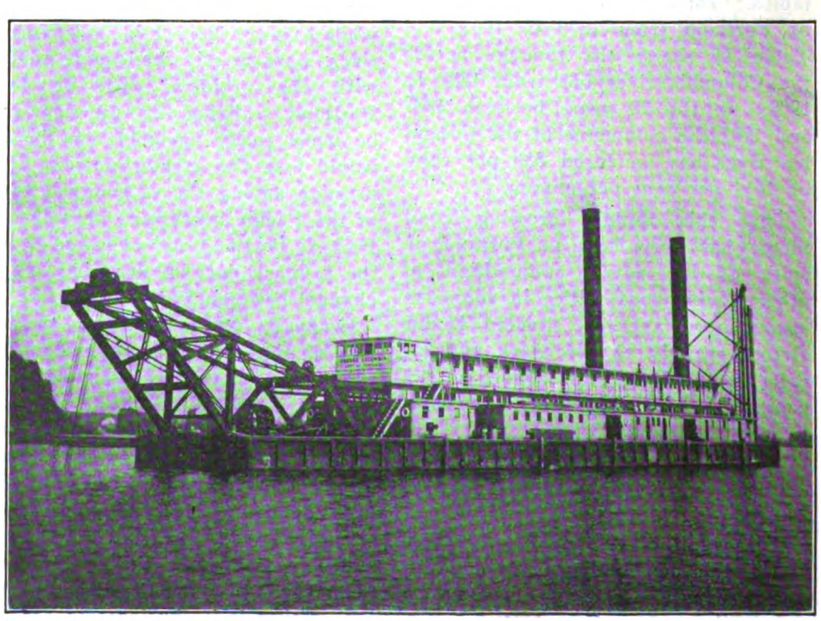


FIG. 2—PORTLAND HARBOR. THIS IS A VIEW LOOKING DOWN THE WILLAMETTE RIVER FROM THE STEEL BRIDGE, SHOWING THE LARGE FLEET OF SAILING VESSELS LOADING WHEAT FOR EUROPE AND THE ORIENT.

president, secretary and treasurer from among their own number. They hire the chief engineer, superintendent of dry dock, clerks and other salaried employes. The organization is small, compact, permanent and efficient and in its operations is a happy contrast to the average political "river and harbor commission."

For its dredging operations the Port of Portland owns two hydraulic dredges. The dredge Portland was built in 1898 and remodeled in 1902. It cost, including the towboat and pipe lines, $70,000. It is 130 ft. in length, 36 ft. beam and 11 ft. in depth. The main engines are 600 H. P. The diameter of the discharge pipe is 20 in. and the capacity of the dredge in sand is 8,000 cu. yds. per day. The dredge Columbia was built in 1902. It is 225 ft. 9 in. in length, 42 ft. beam and 11 ft. 9 in. deep. Its total cost was $240,000. The main engines are 1,500 H. P. The diameter of the discharge pipe is 30 inches and capacity of the dredge in sand is 20,-



DREDGE COLUMBIA, OWNED BY THE PORT OF PORTLAND, PORTLAND, ORE.

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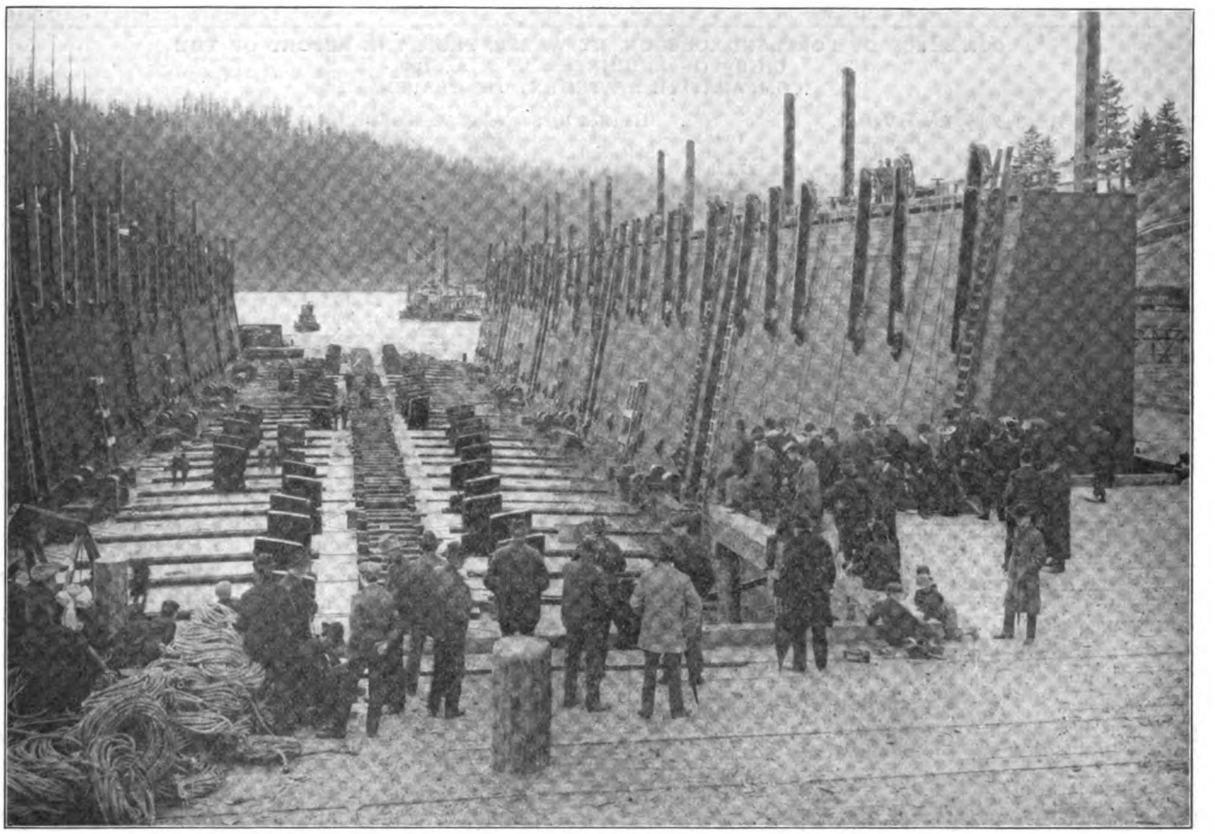

PORT OF PORTLAND'S SECTIONAL FLOATING DRY DOCK.

000 cu. yds. per day. The daily cost of operating the dredge Columbia is $280; the daily cost of operating the dredge Portland is $160. In 1903 the dredge Columbia, working 12 months, excavated 2,191,124 cu. yds. of clay and sand from the ship channel at a cost of $67,778.93 or 3.9 cents per cu. yd. Table III, published herewith, shows in detail the cost of the dredging.

Portland Dry Dock.

The dry dock of the Port of Portland is a sectional floating dock, 468 ft. in length, 82 ft. in width between wings, 25 ft. depth of water over keel blocks, with 10,000 tons dead weight lifting capacity. The dock will take vessels up to 500 ft. in length. The rates for using the dock for 24 hours are as follows:

Steam Vessels on Gross Tonnage.

Up to 999 tons	24 cents per ton.
1,000 to 1,999 tons	21 cents per ton.
2,000 to 3,999 tons	18 cents per ton.
4,000 tons and over	15 cents per ton.

Sailing Vessels on Net Tonnage.

Up to 599 tons	19 cents per ton.
600 to 999 tons	17 cents per ton.
1,000 tons and over	15 cents per ton.

Minimum charge for any vessel, $40.00.
Additional charges, specified in the tariff, are made for lay days in the dock.

In 1907, 61 vessels were docked, the largest being the steamer Terje Viken, 3,579 tons; in 1908, 41 vessels were docked, the largest being the steamer Madura, 4,484 tons.

The charter of the Port of Portland, section 5, paragraph 4, of the Revision and Amendment of 1901, reads: "4. That said dock shall be so located and constructed as that at extreme low water in the Willamette river, the same shall admit vessels drawing 25 ft. of water; *provided, always,* that nothing herein contained shall be so construed as to authorize the Port of Portland to carry on the work of repairing, cleaning or painting vessels; but, that under such rules, regulations and charges as the said Port of Portland may make, the said dock shall be at all times open to various mechanics of the city of Portland for the performing of such work." The port merely furnishes the dock; it does not repair vessels.

Will Operate Towing Service.

When the towing service is organized the Port of Portland will operate steel sea-going bar tugs and steel, stern wheel river tugs. The bar and river pilots will be employed by the port commission and the port charges will be as low as any other similarly situated Pacific harbor. The commission will do no local or commercial towing, but will confine itself strictly to towing deep sea vessels to and from the ocean.

The security of traffic and harbor improvements secured by the Port of Portland has encouraged the investment of private capital in other shipping facilities so that today Portland has one of the best equipped harbors in the west.

There are 22 ocean docks in Portland, with a minimum depth of water of 25 ft.; the depth at the principal docks is from 30 to 40 ft. These docks are located so that the ships in entering or leaving the harbor pass but one drawbridge; this is the double track span of the Spokane, Portland & Seattle railway, which has a clearance of 230 ft. on each side of the draw pier, with a vertical clearance at low water of 56½ ft. The largest dock is that of the S. P. & S. Ry.; this pier is 900 by 170 ft. in size, two stories high. It is fitted with a grain elevator and cleaner so that the grain can be taken from cars in bulk, put

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TABLE I.

COMMERCE OF PORTLAND, OREGON, BY WATER, FROM THE REPORT OF THE CHIEF OF ENGINEERS, U. S. A., 1908.
COMPARATIVE STATEMENT OF TRAFFIC.

	Handled by River Vessels.		Handled by Sea-going Vessels.				Handled by River and Sea-going Vessels.	
Year.	Tons.	Estimated Value.	Tons Receipts.	Tons Shipments.	Tons Total.	Estimated Value.	Tons.	Estimated Value.
1898	1,121,161	.....	27,776	488,818	516,594	.....	1,637,755	.....
1899	1,489,708	.....	36,253	336.134	372,387	.....	1,862,095	.....
1900	1,287,582	.....	32,905	489,385	552,290	.....	1,809,872	.....
1901	1,534,780	.....	29,548	639,736	669,284	.....	2,204,064	.....
1902	1,567,336	.....	145,514	985,912	1,131,426	.....	2,698,762	.....
1903	1,596,220	.....	173,006	659,178	832,184	.....	2,428,404	.....
1904	1,905,451	$30,775,609.00	229,833	548,495	778,328	$27,281,302.00	2,683,779	$58,056,911.00
1905	2,313,153	26,712,339.00	210,026	736,779	946,805	31,786,607.00	3,259,958	58,498,946.00
1906	2,331,121	26,377,640.00	226,656	974,317	1,200,973	34,407,991.00	3,532,094	60,785,631.00
1907	2,586,964	31,583,804.00	572,441	1,092,276	1,664,717	45,000,000.00	4,251,681	76,583,804.00

TABLE II.

TONNAGE ACROSS COLUMBIA RIVER BAR, COMPILED FROM REPORTS OF U. S. ENGINEERS.

		AMERICAN.		BRITISH.		OTHERS.		COASTWISE.		TOTAL.	
		No.	Tonnage.	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.
1887	In	9	11,839	106	114,446	2	1,475	190	276,869	307	404,629
	Out	7	9,280	113	120,122	1	851	185	276,665	306	406,918
	Total	16	21,119	219	234,568	3	2,326	375	553,534	613	811,547
1891	In	7	9,954	95	124,837	7	7,826	393	332,374	502	474,991
	Out	7	10,849	73	94,490	6	6,619	381	331,963	467	443,921
	Total	14	20,803	168	219,327	13	14,445	774	664,337	969	918,912
	Total	47	36,483	137	223,995	18	24,173	334	365,232	536	649,883
1895	In	31	22,673	122	201,042	20	30,115	589	473.433	762	727,263
	Out	31	22,246	122	209,973	14	22,776	546	478.037	713	733.032
	Total	62	44,919	244	411,015	34	52,891	1135	951,470	1475	1460,295
1900	In	8	5,830	101	191,078	49	89,332	320	290.188	478	576,428
	Out	7	4,738	91	174,235	49	86,195	300	303,317	447	568,485
	Total	15	10,568	192	365,313	98	175,527	620	593,505	925	1144,913
1904	In	11	7,588	31	68,563	37	82,315	497	414,806	576	573,272
	Out	24	25,068	32	71,395	32	69,413	484	393,793	572	559,669
	Total	35	32,656	63	139,958	69	151,728	981	808,599	1148	1132,941
1907	In	8	12,553	71	172,518	78	189,775	881	1079,346	1038	1454,192
	Out	10	11,351	61	151,859	69	170,426	842	906,063	982	1239,699
	Total	18	23,904	132	324,377	147	360,201	1723	1985,409	2020	2693,891

through the elevator, cleaned, sacked and loaded without further handling. The Oregon Railroad & Navigation Co.'s dock at Albina is 800 ft. long; the San Francisco & Portland Steamship Co.'s dock is 600 ft. in length. All these docks are equipped with 100-ton electric derricks, electric conveyors, and the lumber docks are provided with chutes as well as electric slings. The docks are provided with railway spurs and the necessity for employing labor in handling freight is reduced to a minimum.

Price of Oil and Coal.

The price of steam coal delivered to ocean steamers at Portland ranges from $4.50 to $6 per gross ton. The principal bunkers available to ocean steamers are located on the west side where there is a depth of water of 50 ft. The bunkers are provided with electric hoists and electric conveyors. The bunkers have a capacity of 8,000 tons and having dockage facilities can handle 3,000 tons on the dock. The coal used by the ocean steamers comes from Wellington, B. C., South Prairie, Wash., and Black Diamond, Wash. These are all good quality, bituminous steam coals.

The fuel oil docks have a depth of water of 40 ft. and are provided with the most approved appliances for loading oil economically and safely. A large number of local steamers burn crude oil. The average cost of the fuel oil is $1 per barrel of 42 gals.

Several docks provided with passenger facilities are devoted exclusively to river traffic.

In connection with the harbor facili-

TABLE III.

THE PORT OF PORTLAND.
COST OF VARIOUS DREDGING WORK.
DREDGE COLUMBIA.

Year.	Location of Work.	Kind of Material.	Average Length Pipe Line. Feet.	Av. Lift. Feet.	No. Cu. Yards.	COST PER YARD Dredging. Cents.	Shore Work. Cents.	Total. Cents.	Total Cost.
1903	Ship Channel	Clay and sand	1000	3	2,191,124	3.9	....	3.9	$67,778.93
1904	Ship Channel	Gravel and driftwood	1000	3	1,135,529	3.52	....	3.52	40,008.96
1905	Ship Channel	Gravel and driftwood	1000	3	532,253	8.4	....	8.4	44,782.84
1906	Ship Channel	Gravel and driftwood	1000	3	542,651	5.65	....	5.65	30,685.76
1907	Ship Channel	Gravel and driftwood	1000	3	116,075	8.7	....	8.7	10,103.62
1907—8	Portland—S. P. & S. Ter. Yards	Sand, gravel and driftwood	2500	24	265,259	8.75	4.5	13.25	35,137.21
1908	Willamette Bridge	Clay, sand and driftwood	2000	10	160,917	5.27	1.4	6.67	10,756.70

DREDGE PORTLAND.

Year.	Location of Work.	Kind of Material.	Average Length Pipe Line. Feet.	Av. Lift. Feet.	No. Cu. Yards.	COST PER YARD Dredging. Cents.	Shore Work. Cents.	Total. Cents.	Total Cost.
1905	Vancouver Channel	Sand and driftwood	1000	3	321,770	4.76	....	4.76	$15,310.10
1906	Vancouver Channel	Sand and driftwood	1000	3	253,415	4.67	....	4.67	11,825.82
1907	East Portland—Bl. A2 & 61	Sand, gravel and driftwood	3000	20	29,317	29	5.82	34.82	10,206.86
1907	East Portland—Bl. A3	Sand, gravel and driftwood	1500	16	10,455	21	2.24	23.24	2,430.19
1907	East Portland—Bl. 58	Sand, gravel and driftwood	2500	22	21,062	22.8	3.63	26.43	5,567.60
1907	East Portland—Bl. 60	Sand, gravel and driftwood	1750	16	18,075	21	2.24	23.24	4,201.44
1907	East Portland—Bl. 83	Sand, gravel and driftwood	2000	16	8,526	21	2.24	23.24	1,981.81
1907	East Portland—Bl. 85	Sand, gravel and driftwood	2500	20	18,474	24.3	2.77	27.07	5,001.12
1908	Weidler Dock, Portland	Sand, gravel and driftwood	1000	16	167,637	8.16	9.88	18.04	44,730.24

Above costs do not include interest, depreciation nor administration expense.

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TABLE IV.

PORT OF PORTLAND.

Statement of Receipts and Disbursements in all Funds for Two Years, January 1, 1907, to December 31, 1908.

GENERAL FUND.			
Receipts.			
Taxes 1907-1906, and delinquent		$267,495.84	
Received from United States Engineers for channel work, December, 1906, January and February, 1907—			
Below Portland	$ 9,473.77		
Vancouver channel	4,572.51		
Contributions for operating expense of dredges on private work—			
Dredge "Portland"	38,356.38		
Dredge "Columbia"	73,550.03	$125,952.69	
Sundry receipts, scow rent, etc.—			
Dredge "Portland"	396.30		
Dredge "Columbia"	1,145.30	1,541.60	
By credit of uncashed checks and interest coupons		392.21	
Disbursements.			
Interest on Port of Portland 5% bonds			$ 35,225.00
Operating expense of dredges—			
Dredge "Portland"			105,194.86
Dredge "Columbia"			178,791.22
Cost and operating expenses of launch			3,417.38
General expense, office, engineering, legal, etc.			16,428.44
Overdraft, December 30, 1906			4,982.74
Cash balance December 31, 1908			51,342.70
		$395,382.34	$395,382.34
DRY DOCK FUND.			
Receipts.			
Taxes 1907-1906, and delinquent		$ 37,319.89	
Received from dry dock earnings		37,177.23	
Balance December 31, 1906		17,110.49	
Disbursements.			
Interest on dry dock bonds			$ 31,980.00
Operating expenses of dry dock			31,264.73
Construction			14,569.30
Balance December 31, 1908			13,793.58
		$ 91,607.61	$ 91,607.61
REFUNDING BOND FUND.			
Receipts.			
Taxes 1907-1906, and delinquent		$ 74,659.22	
Disbursements.			
Interest on refunding bonds			14,620.00
60 refunding bonds redeemed			60,000.00
Cash balance December 31, 1906		4,714.13	
Cash balance December 31, 1908			4,753.35
		$ 79,373.35	$ 79,373.35

ties of Portland mention should be made of the new floating dry dock of the Oregon Dry Dock Co. This company operates in close sympathy with the Willamette Iron & Steel Works, which has extensive repair facilities at its disposal. The new dock is 285 ft. long over the body with a total length, including the overhanging aprons, of 340 ft. Its over all width is 77 ft. and its deadweight capacity is 4,000 tons. This dock will be an important addition to the marine equipment of Portland harbor, since it is the only one small enough to handle 4,000-ton ships and under with economy.

The Problems of Portland.

In these days when the improvement of inland waterways is a subject of great national importance, the harbor improvements at Portland, effected so largely through the corporate organization of the Port District, are a matter of wide public interest. The problems confronting Portland are not vastly different from those confronting the average commercial river city. The Port of Portland organization, while not ideal in all respects, is a very satisfactory and practical device; it has placed Portland far ahead of most American cities in the matter of harbor improvements and reminds one of the splendid municipal harbor work on the German Rhine. The practicability of the Port of Portland scheme is the chief point in its favor; what we want these days in river and harbor work is practical results, not talk and politics. As is shown by Table IV presented herewith, the financial operations of the Port of Portland are sound and reasonable. Here is one American city of only 250,000 inhabitants maintaining a 25-ft. ship channel of over 100 miles in length in a river carrying large amounts of alluvial matter, supporting a large public dry dock which anyone is at liberty to use for a nominal charge and operating an efficient and economical towage service designed to effect permanent reductions in the port charges. Suppose while we are waiting for the national government to act, that the cities of St. Paul, Davenport, Burlington, St. Louis, etc., would organize port districts and undertake the practical regeneration of the Mississippi river. Would results equal to those obtained on the Columbia river by a far less rich community be realized? The writer will not attempt to answer this question categorically at this time; conditions vary widely. But in working out a practical method for the improvement of our rivers and harbors, the labors and success of the Port of Portland will merit deep and careful consideration by similarly situated communities in other parts of our country.

PUGET SOUND THIRD IN SUPPLYING COAL.

In a table recently issued by the bureau of navigation giving figures of the coal supplied to steamers at American ports Puget Sound ranks third among the districts of the nation. The table embraces a period of three years ending Dec. 31, 1908, giving to the district of Puget Sound a total of 1,493,777 tons. This amount is exceeded only by New York and Baltimore. The former is credited with a steamer coal supply of 13,000,000 tons in three years, while Baltimore delivered 1,600,000 tons, only slightly more than that delivered on Puget Sound.

Average prices of the coal form a feature of the new tabulation. Puget Sound prices are higher than those of the principal eastern ports. Also there was a sharp increase in prices during the past three years. The figures per gross ton are: Puget Sound, 1908, $4; 1907, $3.70; 1906, $3; New York, 1908, $3.35; 1907, $3.07; 1906, $2.97; Boston, 1908, $4.15; 1907, $4.20; 1906, $4.07. Coal at Boston is always higher than on Puget Sound.

The figures for the consumption of the various districts of the Pacific are as follows: Puget Sound, 1,493,777 tons; Columbia river, including Portland, 95,306; San Francisco, 703,090 tons in three years. The average prices for 1908 are as follows: Puget Sound, $4; Columbia river, $5.13; San Francisco, $7.04. A large share of the steam coal sold on the Columbia river and at San Francisco is mined in western Washington.

The board of directors of the Trade League of Philadelphia, at a recent meeting, voiced their opposition to the city's plan to build new piers, claiming that it is useless to spend money in constructing such piers without having sufficient water space to safely dock the type of vessels which will use them. The board, however, endorsed a resolution urging that Congress provide for a 35-ft. channel for the Delaware river.

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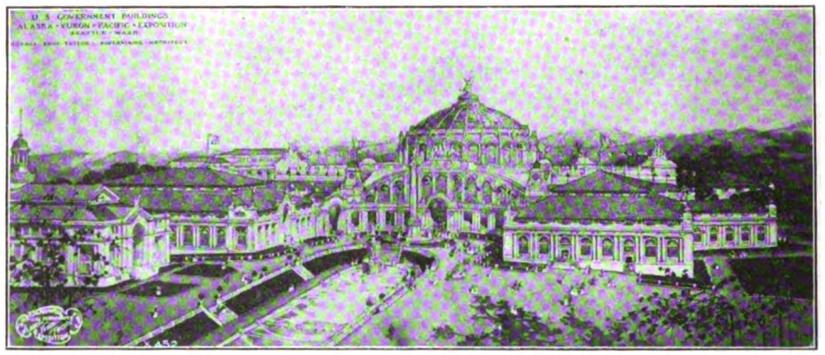
Marine Exhibits at the Alaska-Yukon-Pacific Exposition.

A Large Number of Exhibits of Special Interest to Navigators and Marine Engineers Will be Displayed---Puget Sound Harbors and Ship Yards Will Also Prove of Great Interest.

THE ALASKA-YUKON-Pacific Exposition, which will be held at Seattle, Wash., from June 1 to Oct. 16, of this year, is intended primarily to exploit the resources, advantages and opportunities in the great territories bordering on the north Pacific ocean. Particular attention will be paid to the western coast of the United States, Alaska, Japan, the Philippines and Hawaii. Marine commerce and navigation are so closely interwoven with the development of this great region that, of necessity, the marine exhibits at the exposition will be particularly prominent. The steamship is represented in the official design of the exposition as one of the three most important agencies contributing to the upbuilding of the Alaska-Pacific territory.

One of the most commendable features of the fair both from the standpoint of the spectator and the exhibitor, is that it will be ready *on time*. This is now an assured fact. Other international fairs have failed dismally in this respect; the A. Y. P. management has made a special effort to have the exposition ready promptly on June 1. The buildings as a whole

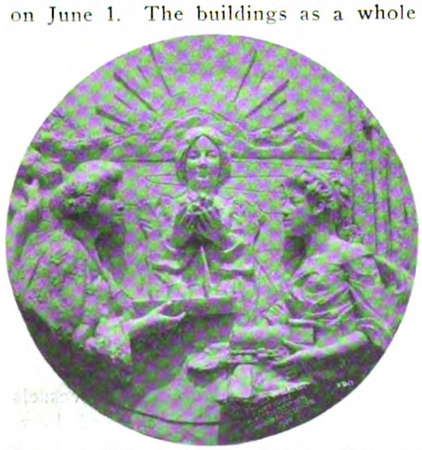


GOVERNMENT BUILDING CONTAINING A LARGE NUMBER OF MARINE EXHIBITS.

are now over 90 per cent completed; many of them were finished in 1908, and they will all be done by May 1, 1909. The pavements are laid; the grading is done; the grass plots are sodded and the flower beds are in bloom. The Alaska and manufactures buildings are finished; the machinery hall has been completed since November, 1908; all of the buildings that will house marine exhibits are finished; some of the exhibits are already in place.

The marine and navigation exhibits will be found in various appropriate buildings among which are the government buildings at the head of the cascades, the manufactures and liberal arts building, the Alaska building and the machinery hall. Several large manufacturers of marine engines, boilers and steamboat machinery will exhibit in the machinery hall. There is excellent opportunity in this building for the display of machinery to the best advantage. The building itself is a permanent structure of heavy mill construction. It is provided with both direct and alternating current electricity of any commercial voltage; compressed air and high or low pressure steam is also available.

Among the exhibits which will be of particular interest in marine engineering and transportation circles



OFFICIAL DESIGN OF THE ALASKA-YUKON-PACIFIC EXPOSITION.

MANUFACTURERS' AND LIBERAL ARTS BUILDING.

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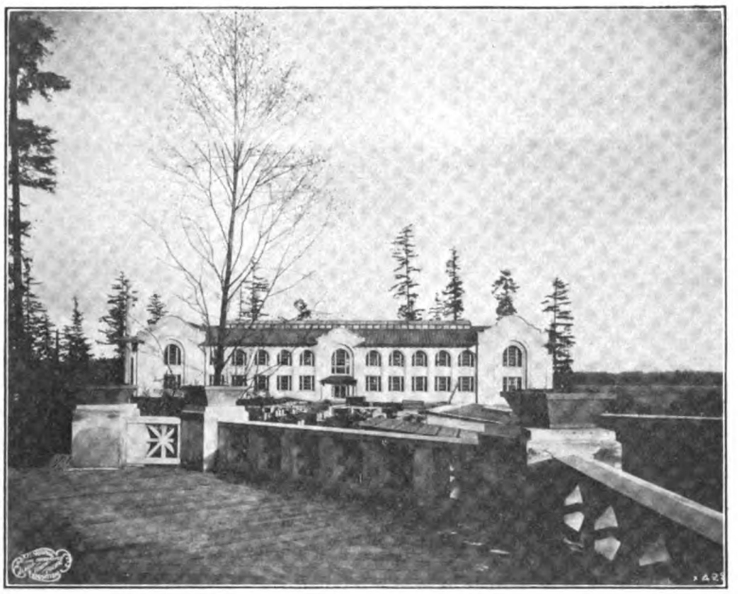

MACHINERY HALL, WHICH WILL BECOME THE PERMANENT SCHOOL OF ENGINEERING OF THE UNIVERSITY OF WASHINGTON.

is the display of boats and equipment used in the sealing, whaling and salmon fishing industries of Alaska. These will be grouped in the Alaska building. In this building also will be a complete exhibit of the water transportation facilities of Alaska with models of the Seattle-Alaska steamships, of the Yukon river steamers and of the docks and harbor facilities of the principal Alaskan ports. These models will be supplemented by numerous photographs and drawings which show comprehensively the development of navigation and marine commerce in Alaska.

The government exhibits will also be of special interest to navigators and ship builders. The bureau of fisheries will exhibit a model of the sea-going steamer Fish Hawk which is used for biological investigations and as a floating shad hatchery. The department of commerce and labor will exhibit a file of its publications on the development of commerce and the safe-guarding of navigation.

The lighthouse department will be unusually well represented. Full sized specimens of lenses and lanterns, with operating mechanism illustrating the methods of producing distinctive flashing lights will be displayed. The exhibit illustrating the development of the lamps used in lighthouses will show a complete line from the oldest devices down to the new oil-vapor lamp which produces an intense light with a small consumption of oil and a great decrease in heat. Different sorts of signalling apparatus for use in case of fog will be shown in actual operation. There will also be complete models of typical and extraordinary lighthouses and model light ships of the latest patterns.

The coast and geodetic survey will exhibit models of its ships, will show the methods of making charts, and will display a complete line of charts, pilot rules and tide tables.

The lifesaving service will have a model station in charge of a competent crew located on Lake Washington; the station will be equipped with a complete outfit of the most approved types of lifesaving apparatus. It is probable also that the new lifesaving tug Snohomish, stationed regularly at Cape Flattery, will be at anchor in Seattle harbor part of the time.

In addition to these exhibits at the exposition grounds, the harbor of Seattle will furnish a display of actual vessels from the smallest tug to the 28,000-ton Asiatic liner Minnesota. These boats, as far as possible, will be open to public inspection. The ship yards of Puget Sound will give the visitor an excellent opportunity to study the methods of Pacific coast ship builders at first hand. Those interested in naval affairs will have excellent opportunities to visit the big navy yards at Bremerton, 15 miles west of Seattle. The equipment of this yard is unusually complete and includes the largest dry dock on the Pacific coast.

A LARGE MARINE BOILER BUILT ON THE PACIFIC COAST.

ONE OF the largest marine boilers ever constructed on the Pacific coast is now being built by the Commercial Boiler Works, Seattle, for installation in the Puget Sound Tug Boat Co.'s tug Lorne. As an example of the most advanced practice in marine boiler construction on the Pacific coast, the description and drawings of this boiler are of interest.

The boiler will furnish the entire steam supply for the main and auxiliary engines of the Lorne. The Lorne

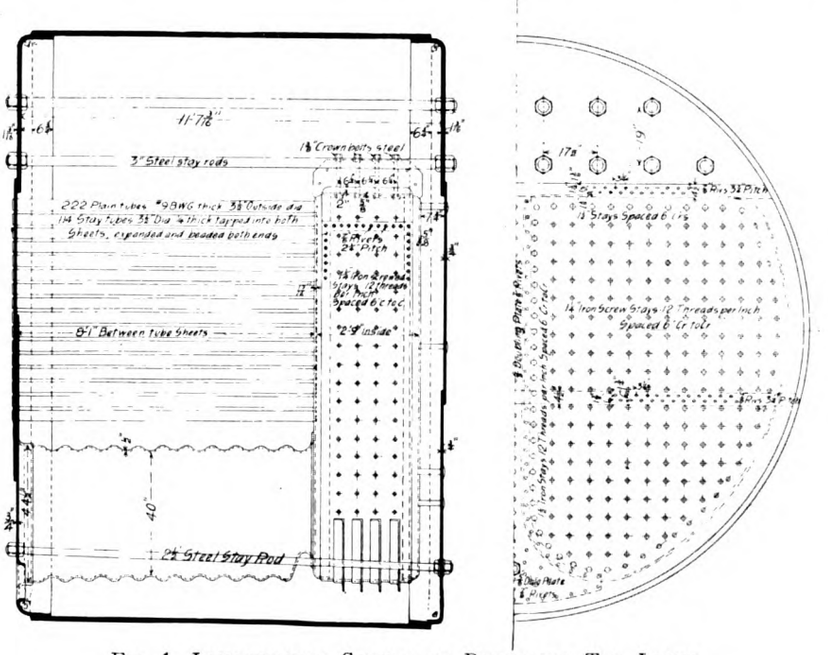
1F 7/8"
1/4 Crown bars steel
3" Steel stay rods
222 Plain tubes .098 W.G. thick 3 1/4" Outside dia
14 Stay Tubes 3 1/4" Dia .148 thick tapped into both Sheets, expanded and beaded both ends
81" Between tube Sheets
40"
2" Steel Stay Rod
17 3/8"
14 Stays Spaced 6" c/c
14 Ironsteen Stays 12 Threads per inch Spaced 6" c/c

FIG. 1—LONGITUDINAL SECTION OF BOILER FOR TUG LORNE.

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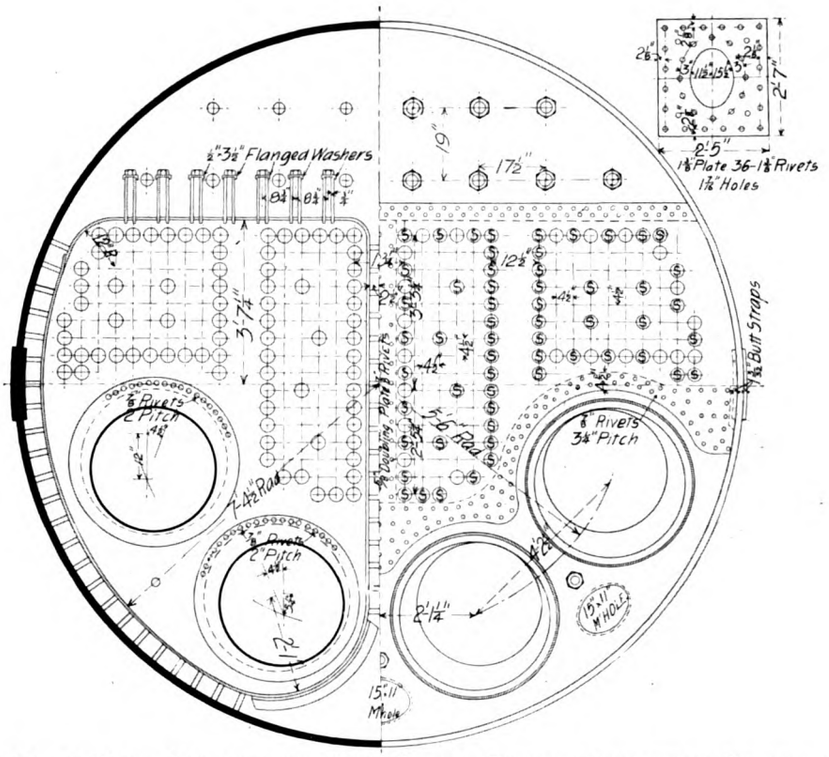

FIG. 2—FRONT ELEVATION AND CROSS-SECTION THROUGH COMBUSTION CHAMBER OF BOILER FOR TUG LORNE.

is a wooden, sea going tug 151 ft. in length, 26 ft. beam and 13.2 ft. in depth fitted with a single triple expansion engine of 1,100 indicated horsepower. The engine cylinders are 18, 24 and 48 inches in diameter by 36-inch stroke.

As is seen from the accompanying drawing, Fig. 1, the boiler is of the single ended, internal furnace, shell type. It is built to fulfill the requirements of the British Columbia Marine Inspection. The boiler will carry 170 pounds per sq. in. steam pressure. It is 11 ft., 7 3/16 in. in length and 16 ft. diameter. The total water-heating surface is 2,985 sq. ft. In computing the water heating surface one-half the area of each furnace shell is taken, together with the tube area and the net area of the combustion chambers.

The shell is of open-hearth boiler steel with a tensile strength of from 56,000 to 64,000 pounds, with other physical properties in proportion. The shell is made of two plates each 25 ft. long, 11 ft. wide and 1⅜ in. thick. This gives a boiler of a maximum and uniform strength. There are no ring seams and only two longitudinal seams in the shell. The latter are butt joint, double strap riveted seams with three rows of staggered rivets in each plate. The rivets are 1⅜ in. in diameter, riveted in 1 7/16-in. drilled holes. As in shown in Fig. 3, the pitch of the rivets in the two outer rows in each plate is 4½ in.; the pitch in the inner row is 8½ in. The butt straps are 1⅜ in. in thickness.

The stayed portion of the head is 1 3/16 in. thick and the tube sheet is 13/16 in. thick. The head is riveted to the shell by a double staggered row of 1⅜-in. rivets, pitched 4⅝ in.

There are two combustion chambers stayed on the back and sides with 1¼-in. iron screw stays spaced 6 in. center to center. The top of the combustion chamber is stayed with seven crown stays, each carrying four 1⅜-in. steel crown bolts. The main stays are 3 in. in diameter spaced 17½ in. horizontally and 19 in. vertically.

There are 222 plain tubes, each 3½ in. in outside diameter and 0.143 in. thick (No. 9, B. W. G.), and 114 stay tubes, each 3½ in. in diameter and ¼-in. thick. The stay tubes are expanded and beaded into both tube sheets. There are 336 tubes in all with a total water-heating surface of 2,488 sq. ft. The stay tubes are marked "S" on the drawing, Fig. 2.

The four internal furnaces are made of ½-in. corrugated plate. The furnaces are 40 in. in internal diameter. The four grates are each 6 ft. 6 in. in length by 41 in. in width, placed with a slope of ½-in. per ft. toward the combustion chamber. There are two furnaces to each combustion chamber. The total grate surface is 88.80 sq. ft., and there are 33.6 sq. ft. of water heating surface per sq. ft. of grate area.

The fittings, except the safety valve and the main stop valve, are all mounted on the back head of the boiler which opens into the engine room of the tug. The safety valve is a 3½-in. twin valve manufactured by T. McAvity & Sons.

Although the Commercial Boiler Works will have to pay a duty of 27½ per cent ad valorem on this boiler, the contract was obtained by the American firm in competition with several boiler makers who would be exempt from this charge.

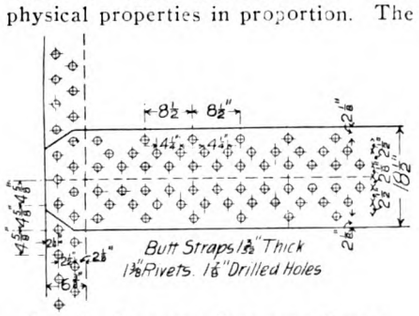

FIG. 3—SHOWING PITCH OF RIVETS.

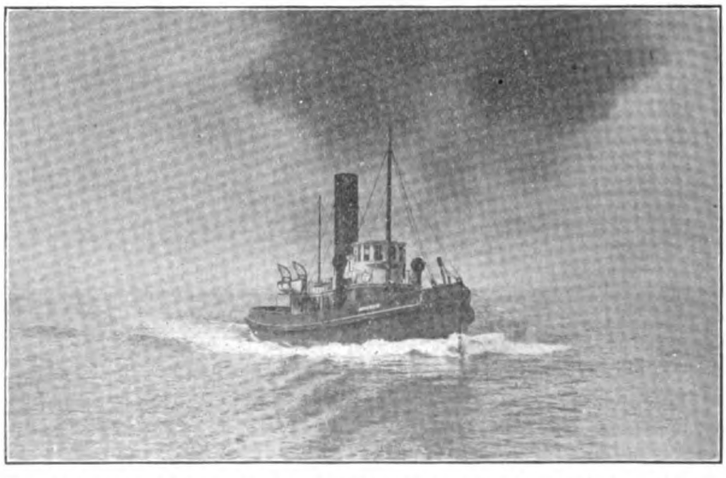

FIG. 4—BRITISH TUG LORNE FOR WHICH THE BOILER IS BEING BUILT.

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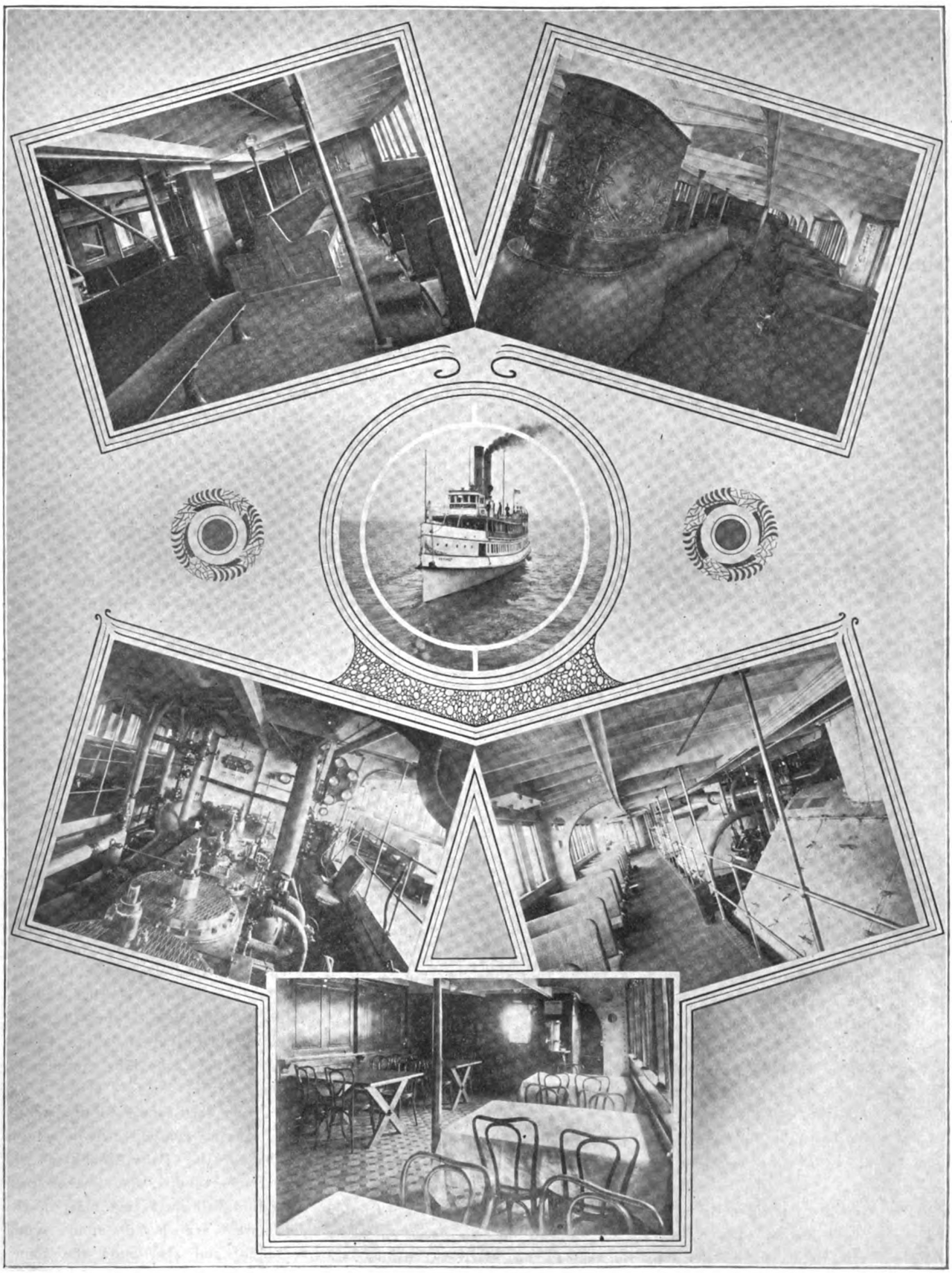
Steamer H. B. Kennedy, Described in the April Issue.



Ladies' Cabin, Finished in Ash and Red Plush.

Steamer H. B. Kennedy Leaving Her Dock at Seattle.

Main Cabin, Finished in Mahogany and Green Leather.

Engine Room, Four-Cylinder, Triple-Expansion Engine.

Boiler Room, Two Ballin Water-Tube Boilers.

Dining Room.

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POSSIBILITIES OF IMPROVEMENT IN AUXILIARY MACHINERY.

The paper in another column on "Electrical Installations Aboard Ship," which is necessarily somewhat abridged, is based upon European practice and refers more particularly to a passenger and freight steamship for ocean service. The consequent rapid corrosion in conduit systems referred to is not, therefore, met with in fresh water service, such as the large steamships on the great lakes, where this system is very extensively employed. A reference is also made to a single wire system using the ship herself as a return circuit, which does not find a place in United States practice.

The principal feature of the paper, however, is its treatment of the subject of electrically-operated auxiliaries. In previous issues of the MARINE REVIEW this has been very fully dealt with in connection with the subject of gas power aboard ship and the problems have been very carefully worked out. There can be no doubt whatever that, so far as economy of operation alone is concerned, the electrical installation is far in advance of the ordinary steam equipment, but the latter is so thoroughly reliable and so familiar to all hands that it is doubtful if the electrically-operated apparatus will successfully supplant it so long as steam remains the motive power, but there is decided room for improvement, even in the existing steam apparatus. For example, in the pumping system. The ordinary reciprocating pump, as commonly used, is well known to be the most extravagant type of steam motor in use. The recent development in turbo-pumps in single and multiple stages makes it possible to handle water with comparatively high efficiency up to pressures rather in excess of any now used afloat, and it is rather singular that they have not made way for boiler feeding, fire service, and similar work. The direct-acting reciprocating pump has been a good servant, and is familiar to every engineer, but it is also one of the first places where he looks for, and generally finds, trouble. With the turbo-pump, speed regulation of the pump itself is not at all necesary, the only valve that it is necessary to manipulate being the feed regulating valve at the boiler, or the hose valve on the fire line, as the case may be, and the entire absence of valves, springs, studs and seats in the pump removes many of the annoyances and difficulties of ordinary practice. Even non-condensing, turbo-pumps can be operated at a steam cost of one-third to one-half that of standard forms of reciprocating pumps and the saving in space is almost or quite as great. The objections urged against electrically-driven windlasses and capstans have been carefully and thoroughly considered and overcome without the introduction of the friction clutches and special circuit breakers suggested and electric capstans are now in common use.

As to electrically-operated steering gears, it may be noted that they have been in successful operation in the United States since 1893, and we might mention the steamship Minnesota of the Great Northern Railway's Trans-Pacific line as an instance. The gear employed in this case is described elsewhere in this issue. Electric winches are also used successfully and quite extensively for an infinite variety of services, including that aboard ship, and, while it is true that their cost is considerably higher than that of steam winches of corresponding capacity, the economy of their use does not admit of argument. The reference to the propulsion of ships by electricity calls to mind that at least three such installations have been already made, and on this subject we shall have more to say later. In conclusion, it may be added that the figures given for the proposed installation evidently contemplate a ship of about 6,000 I. H. P., and the estimate is certainly liberal, though it is somewhat singular that the author gives no consideration to the use of turbine driven generators, a service to which the steam turbine is peculiarly adapted; in fact it furnishes one of the strongest of arguments in support of electrically operated auxiliaries.

COMPARISONS OF LAKE AND OCEAN ENGINES.

In a paper entitled "Some Points in Connection With Shipbuilding on the Great Lakes, U. S. A.," presented at the April meeting of the Institution of Naval Architects (Great Britain) by Prof. H. C. Sadler, of the University of Michigan, the author briefly and very accurately describes the leading features of what has become a distinctive type—the bulk freighter of the great lakes. In regard to the propelling machinery, he says:

"To one accustomed to the stereotyped marine engine certain features of that of the 'Lake Freighter' will appear unorthodox, but further consideration will show that most of the departures are based upon sound reasoning and also upon the somewhat different set of conditions involved.

"The main difference may be traceable to two causes, first the vessels

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ply in fresh water, and, second, owing to the shortness of the season and brief stay in port, the design must be simple and capable of as easy adjustment as possible. Owing to the distance of the lakes from the coast, the early designers were not influenced particularly by the ordinary marine practice, and this, combined with the necessity of decreasing the cost of manufacture, has doubtless led to the adoption of some of the principal details in design."

It is not by any means clear what is meant by "stereotyped marine engine," but it may be assumed to refer to sea-going practice as contrasted with lake practice. It will, we think, be conceded, that even sea-going practice is very far from being uniform and exhibits a wide range or variety in design—in fact it would be rather nearer the mark to characterize the lake design as stereotyped.

But after all, what are the "orthodox" features to which the professor refers? Firstly, these ships are designed for fresh water, which, we take it, is merely incidental.

This, however, makes a condenser unnecessary and the jet type has therefore never been displaced as at sea. This, then, is not a departure at all, rather the contrary, since it was only about 50 years since that the surface condenser succeeded the jet at sea.

It is in the second cause of difference, however, that we cannot clearly grasp the professor's meaning. He surely does not mean to say that simplicity and ease of adjustment are not at all times valuable. Every designer aims to accomplish those very things according to his own ideas which are, more often than not, merely those of others, precedent or contemporary. The lake designers and builders are, therefore, indebted to the professor for a very graceful compliment, and it is not in any way minimized by the further reference to the necessity of reducing cost of construction—another point which no builder of our acquaintance ever overlooks. That the engines have not suffered as a result of these conditions is amply proved by their service, in which a breakdown is almost unknown, although piston speeds on the lakes are materially higher than is usual at sea.

There are, practically speaking, only two essential points of difference between lake and sea practice in design. One of these is the employment of rock shafts in the prevailing type to drive the high pressure valve. We have had occasion to investigate this feature heretofore, and although employed in some hundreds of engines of all sizes we did not learn of a single instance of failure, nor is there any good reason why there should be. The duty is very light indeed; the valves are without exception of the piston type and the inertia strains are very low. There are thousands of locomotives employing the same transmission under conditions a hundred fold worse. That its use results in shortening up the engine is ample justification.

The second point is in the arrangement of crosshead. There are two standard forms of crosshead in seagoing practice; in one the crosshead is forged with the piston rod and embraces the top end bearing brasses, the pin being shrunk into the forked end of the connecting rod. Of all designs this is the most miserable; adjustment is difficult and extremely tedious and generally can be made only at the bottom of the stroke because of the difficulty of getting at the inside bolt, and a lead cannot be taken without jacking the crosshead up to take down the bottom brass. The piston rod has to come out the lower end of the cylinder and when, as sometimes happens, a rod is bent, disconnection is almost impossible.

The second type, in which the crosshead carries gudgeons which are taken by boxes carried on the horns of the top end, while very much better than the first, is more expensive, and on account of unequal wear is apt to throw the crank end of the rod hard on to one crank cheek or another, and frequently results in heat or noisy working.

The lake design with its readily removable pin and straight line bearing and quick adjustment has much to recommend it. We have seen slack taken up in one of these without stopping the engine and we have seen the crosshead blocked and the pin out on the grating and the rod swung clear in five minutes. These are features of real value and aside from the fact that it increases the height of engine slightly there is no good reason why it is not perfectly suitable for any service. These are the only points in which any greater difference is to be found than in different engines at sea, and there are no engines anywhere doing their work more economically than those in the bulk freighters of the great lakes.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The spring meeting of the American Society of Mechanical Engineers was held at Washington, D. C., on Wednesday, Thursday and Friday, May 5, 6 and 7. Professional sessions were held in the forenoon each day, the afternoons and evenings being devoted to social and entertainment features.

At the Thursday morning session a paper by C. Lee Straub, of New York, on "Marine Producer Gas Power" was presented, which we reproduce in full in this issue. It is much to be regretted that time for full discussion of this paper was not available, a number of members signifying their wish to participate. Following Mr. Straub, Mr. Henry Penton was invited to describe in detail the commercial and operating conditions of marine service, which he did, more particularly with reference to the type of ship selected for illustration. Mr. Penton described the operating conditions with steam and the various problems to be considered in substituting gas power, the kinds and grades of fuel available, and showing that it was essentially a bituminous coal proposition. The basis upon which the extinction of cost was calculated was also shown. He drew attention to the fact that the load factor of the marine engine is, in good weather, ideal and very different from the conditions existing in most

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power plants, where gas power has been adopted. In addition to the matter contained in the paper, Mr. Straub also gave a review of the progress made up to date in marine gas power in Europe and America, together with a list of the principal installations. The review was supplemented by an extended report from a well-known naval architect and marine engineer now traveling in Europe. The paper was freely illustrated with slides, and was very well received. It was, in fact, the most interesting paper presented at the meeting.

On Wednesday afternoon the party was entertained by an exhibition drill at Fort Meyer, on Thursday afternoon was received by President Taft, and on Thursday evening was addressed by Rear Admiral George W. Melville, U. S. N., Retired, on "The Engineer in the Navy." We regret that we have not space to reproduce the admiral's address entire. He reviewed the history of the department during his active service and contrasted its operation with the system now proposed, under which the bureau of steam engineering is consolidated with the construction and repair and under the jurisdiction of the chief of that bureau. The admiral paid a touching tribute to his subordinates in the service, and was visibly much affected. He characterized the new method as being contrary to the spirit of the age, which is specialization, and as a step backward. The admiral's address was followed by the presentation of his portrait to the National Gallery, the presentation speech being made by Mr. Walter M. McFarland, vice president of the Westinghouse Electric Co,. of Pittsburg, formerly Admiral Melville's assistant in the bureau. He paid a glowing tribute to the admiral as a chief, saying that he had pre-eminently the faculty of selecting an organization and insuring its loyal and hearty support by never omitting to give them full credit for even the slightest suggestion of value. Director Walcott, on behalf of the nation, accepted the portrait, also making reference to the admiral's services to the country.

The program of the meeting was brought to a close by a trip by steamer to Mt. Vernon on Friday afternoon.

STEEL AND NAVAL CONSTRUCTION.

Elsewhere we reprint an editorial from *The New York Evening Post* of April 22, under the above heading.

We think the author, in assuming that the changes hinted at refer chiefly or entirely to improvements in material, has lost sight of a development, which, it is a good deal more probable Mr. Asquith had in mind, that is to say, the adoption of gas power for propulsion in place of steam. It is entirely reasonable to expect a reduction in engine room and boiler room weights of 25 per cent or upwards, and a further reduction in fuel stowage of 50 per cent for a given cruising radius. The assumption that a saving in these weights would not result in structural improvement, because the saving would be at once devoted to speed, is, we think, a mistaken one, for this, in itself, comes within the category of governing conditions of naval strategy. It is not at all improbable either that the improvement confidently looked for in steel making within the near future will result in a material reduction in hull weights, exclusive of the armor and a further reduction in machinery weights, due to the availability of better material, but the elimination of smoke, resulting from the adoption of gas power, will probably have more effect on naval strategy than all the other influences combined.

In connection with the foregoing, the paper printed elsewhere in this issue on marine producer gas power will prove interesting.

TO REPEAL TONNAGE TAX EXEMPTION LAW.

Senator Frye has proposed an amendment to the tariff bill now under consideration to repeal the so-called reciprocal tonnage tax exemption law of 1886. By the act of 1886 vessels are exempt from American tonnage taxes if clearing from foreign ports where no tonnage on light dues are imposed on American vessels. As is well known, few American vessels cross the Atlantic or Pacific. The act of 1886 works equitably only with the province of Ontario, from which American lake vessels are exempt from about $20,000 tonnage taxes and Canadian vessels from about $15,000. On the other hand, under the law the United States has sacrificed in the last 20 years about $500,000 in revenue from ships from the Netherlands and over $1,000,000 in revenue in ships from German ports. The British parliament is expected in the near future to vote on the bill to abolish light dues which if it passes will exempt British ships from about $325,000 American tonnage taxes annually, whereas American ships will be exempt only from $8,000 in British light dues.

By the repeal of the law of 1886 tonnage taxes imposed on vessels in trade between the United States and Mexico, Central America, the West Indies and British North America (except Ontario) can be reduced 33 per cent. The net fiscal result of the repeal will be to add only about $7,000 to tonnage taxes paid by American vessels and $48,000 paid by foreign vessels. Last year American vessels paid $86,680 tonnage taxes, foreign vessels $988,735, owing to the small amount of American shipping in foreign trade. Netherland ships for years have secured exemption of from $30,000 to $40,000 in the United States, while no American ships enter ports of the Netherlands or Dutch East Indies to secure reciprocal advantages.

In fact, the act of 1886 has proved unbusinesslike in all quarters except on the great lakes where there has been an equitable exchange. Its repeal will, however, mean the payment of about $20,000 by American lake vessels from which they are now exempt and about $15,000 by Canadian vessels.

TAXING FOREIGN-BUILT YACHTS.

Clause 471 A of the tariff bill now under consideration imposes a duty of 35 per cent upon foreign-built yachts. Practically all of the yachts owned by American citizens have been built abroad though American ship builders are quite as capable of constructing them as to foreign builders. The section, if passed, will doubtless promote American ship building to this extent.

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Marine Producer Gas Power.[1]

A Comparison of Producer Gas and Steam Equipments.

By C. L. Straub,* New York, Non-Member.

SO MUCH interest is exhibited both by the engineering profession and the general public in the application of producer gas power to marine, commercial and naval service, that a brief summary of recent progress in this field appears timely.

Any innovation which makes for improvement in present practices, surely, though sometimes slowly, achieves its end. Producer gas power, on impartial analysis, offers so many benefits to marine service that it appears strange indeed that more rapid progress has not been made in its adoption. The delay appears to be due to several causes:

The marine public, who since the days of the Clermont have exclusively associated the term "motive power" with "steam," have every reason for demanding exact and conclusive evidence of the superiority of gas power or any other power, before adopting it in lieu of their present methods. This evidence is only now slowly coming forth. Many who have been credited with authority by the engineering profession and others, either through ignorance or through being misinformed, have beset the way of marine gas power with numberless imaginary obstacles, ridiculous in proportion to the real difficulties, but sufficient nevertheless to instill some doubt of the possibilities of the system, into the minds of the waiting public.

Only recently has such progress been made in the development of gas power for marine work, as to warrant its early adoption in commercial service. Two years ago, less than 300 H. P. in the aggregate was being developed by marine producer gas power installations; these were experimental in nature and were of the German Capitaine type. There are now installed and accepted 23 Capitaine marine plants, aggregating 2,035 H. P., a partial list of which follows:

Emil Capitaine: Launch, 60 B. H. P.; 4-cylinder single-acting, 4-cycle engine; boat 60 ft. long, 10 ft. beam, 4 ft. deep; ran an average speed of 10 miles for 10 hrs. on 412 lbs. of anthracite coal.

Rex: Sea-going Swedish boat; 102 ft. long; 22 ft. beam, carries 350 tons on 9-ft. draught; fitted with a 3-cylinder single-acting, 45-H. P. engine at 300 R. P. M.

Capitaine: Tow boat at Genoa; length 47 ft., beam 12 ft., draught 7 ft.; fitted with a 3-cylinder, single-acting, 4-cycle engine, 105 B. H. P. at 240 R. P. M.

Duchess: Canal barge; length 71 ft., beam 7 ft. 1 in.; carries 20 tons cargo on 42-in. draught; fitted with double-cylinder, single-acting, 4-cycle engine of 25 B. H. P.

Dusseldorf: Tug at Hamburg; fitted with a 4-cylinder, single-acting 4-cycle engine, 60 B. H. P. at 240 R. P. M.

Isee: Tug, fitted with a 3-cylinder, single-acting, 4-cycle engine, 45 B. H. P., 300 R. P. M.

Willhelm: Combination freight and passenger Rhine boat, fitted with a 5-cylinder, single-acting engine, 175 B. H. P. at 240 R. P. M.

Badenia: Rhine freight boat, fitted with a 2-cylinder, single-acting, 4-cycle engine of 30 B. H. P.

Katrina: Canal freight boat, fitted with a 3-cylinder, single-acting, 4-cycle engine, 45 B. H. P.

Marie: Canal freight boat; fitted with a 3-cylinder, single-acting, 4-cycle engine, 45 B. H. P.

Hoffnung: Combination freight and passenger Rhine boat, fitted with a 5-cylinder, single-acting, 4-cycle engine of 210 B. H. P.

Amersie: Volga freight boat, fitted with a 4-cylinder, single-acting, 4-cycle engine of 60 B. H. P.

No. 58: Canal freight boat, fitted with a 4-cylinder, single-acting, 4-cycle engine of 60 B. H. P.

In addition to the above there were a number of freight boats, the dimensions and names of which we were unable to obtain, but whose power plants varied in capacity from 30 to 175 H. P. each.

H. M. S. Rattler: An old gun boat, 165 ft. long, 29 ft. beam, originally fitted with a triple expansion engine. The gas engine is 5-cylinder, single-acting, 4-cycle. Cylinders 20 in. diameter by 24 in. stroke, developing 500 B. H. P. at 120 R. P. M. This engine is started by means of a mixture of gas and air which is pumped into the cylinders at a pressure of about 95 lbs. per sq. in. This complete plant was designed entirely in the Capitaine Works at Dusseldorf. The total weight of the entire plant, including the donkey boiler for working the pumps and auxiliaries, is 94 tons, as compared with 150 tons in the case of the displaced steam engine. A consumption of 1,525 lbs. of coal was made for a measured distance of 45 knots on an average speed of 10½ knots per hr. The cost per mile for fuel with coal at 15s. 6d. per ton is $0.064 U. S. currency. This boat made a maximum speed of 11.3 knots per hr. against a 1½ knot current at 410 R. P. M. of the engine shaft.

All of the above plants by their design and construction are restricted to operation on anthracite coal, coke or hard-burned charcoal and any plant so restricted by its design to one class of fuel is seriously limited in its scope of application. The development of a simple marine gas-producer for use with any class of solid fuel is a necessity, if the system is to be considered seriously by the marine profession.

The writer is fortunate in having been associated with some recent American developments both in stationary and marine gas power plants, a brief survey of a portion of which will enable us to draw more clearly the comparison between a typical steam and a possible gas installation.

Two Types of Stationary Gas Producer.

There are in commercial operation in this country today two distinct types of stationary power gas producers which are suited by their design for operation on almost any class of solid fuel. They may, by their systems of operation, be qualified as up-draft and down-draft producers.

In the up-draft producer, the fuel is charged into the generator through an air-tight mechanism at the top, while air and steam, or air and products of combustion are admitted at the bottom of the fuel bed, and passing upward, leave the generator at the top in contact with the fresh fuel. Almost all of the hydro-carbons leave the generator unfixed with the hot gas, only to be condensed later in the gas coolers or scrubbers and gas mains, forming large amounts of tar, which, if not removed to a minute degree, will positively prevent the operation of the engine. The removal of this tar is troublesome and is accomplished at a loss of power and efficiency. The fuel in the upper zone of the bed in the up-draft producers cokes and cakes so seriously as to require continuous poking of the fuel bed, either mechanically or by hand. These features and others in this type of apparatus contribute to limit the rates of combustion per sq. ft. of grate to a relatively low quantity. All things considered, therefore, this type of apparatus has not lent itself agreeably to modification for marine service.

In the down-draft type of apparatus, the fuel is charged by hand through a large door at the top of the producer, which is normally in an open position, allowing the operator unrestricted inspection of the whole upper zone of the fuel bed. The hydro-carbons contained in the fuel are driven off in the upper zone, mixed with air and almost completely burned, and the burnt products, passing downward through the relatively deep bed of fuel, are decomposed and regenerated into carbon-monoxid and hydrogen gases. All of the tar and the lighter hydro-carbons are completely fixed in this

[1]Paper read before the American Society of Mechanical Engineers, Washington, D. C., May, 1909.

*With the Loomis-Pettibone Co., New York.

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process, and no tar is found in condensation in any portion of the plant after cooling. Coking or caking of the fuel beds is not detrimental, but on the other hand, assists in keeping the fire in the open porous condition, which is desirable and necessary where high rates of combustion obtain. This feature eliminates the poking necessary in the up-draft apparatus. The gas leaves the bottom of the producer through brick-lined connections, and a portion of the sensible heat is extracted in passing through an economizer. The gas is then cooled and washed and passed through an exhausting mechanism, whence it is delivered under pressure to the engine.

This type of apparatus lends itself admirably to the high rate of fuel combustion, which for the sake of economy in space and weight is desirable in marine service. There are in actual commercial operation today, a number of plants of this type having an average fuel consumption of over 40 lb. of good bituminous coal per sq. ft. of grate per hour. These producers are sold on a rating of from 18 lb. to 20 lb. of fuel per sq. ft. of grate per hour, which is almost 100 per cent greater than the average rating of the up-draft type of producers.

Measuring the Two Systems.

Undoubtedly a better method of measuring the ability or success of these two systems, is to make note of the number and capacity of plants of each type in actual operation on engine service. A report of the committee on gas engines of the National Electric Light Association, spring of 1908, showed that in gas engine power plants, of capacities of over 300 H. P. each, there were in operation 32 plants of both types having a total capacity of 57,225 H. P. Of these, 4 plants were of the up-draft type, having an aggregate capacity of 4,050 H. P., and 28 plants were of the down-draft type, with an aggregate capacity of 53,175 H. P. The latter contain the Loomis-Pettibone gas-generating apparatus, some of which has been in operation on engine service for 13 years.

Three years have been devoted to the modification of these stationary plants for marine service. The work involved a reduction in the size and weight of the generators; complete revision of the scrubbing, gas cleansing and exhausting mechanism; elimination of all gas holders, storage receptacles, mixing chambers, etc.

The plant as modified to date has a light, compact producer, which while retaining the same rate of combustion as the stationary apparatus, has materially reduced dimensions and weight of the shells, brick lining, fittings, etc. The economizer boilers which were used on stationary work have been abandoned, and replaced with light air-heating economizers. The gas-coolers no longer contain any coke or broken material, or wooden trays, and are built of very light, non-corrosive sheet metal, and arranged for either vertical or horizontal position, the latter arrangement being convenient for space which would be otherwise wasted in the vessel. The cooled and partially cleansed gas is drawn through the above portion of the plant by a centrifugal gas-cleaning exhauster, driven by direct-connected motor. The gas passes directly from the exhauster under pressure, through an automatic pressure regulating valve, to the engine manifold.

That the plant is adaptable for marine service with regard to space occupied and weight, may be seen from the following conservative estimate:

Plants of from 100 to 500 H. P. each occupy from 0.4 to 0.5 sq. ft. per H. P., and weigh from 70 lb. to 90 lb. per H. P., including all auxiliaries, piping, etc.; plants of from 500 H. P. to 1,000 H. P. occupy from 0.3 sq. ft. to 0.45 sq. ft. per H. P. and weigh from 40 lb. to 70 lb. per H. P., including all auxiliaries, piping, etc.

Undoubtedly the rational opportunity at the present time for marine gas power lies in commercial service, in which regard the most rapid advancement in America has been made in the freight, ore and fuel carriers of the Great Lakes.

Gas Installation for a Lake Freighter.

We have therefore taken for our example a ship built from the designs of Messrs. Babcock & Penton within the last year. For the sake of clearness, the views show only the machinery space; all of the ladders, stairways and grates have been omitted from the plans, and the piping is shown only on the gas installation. The machinery installation proper is all there, however, and while the parts eliminated are merely accessory, the contrast between the two plants would be all the more striking were they included.

The boat is a modern lake freighter and represents the best standard practice in this service. She is 306 ft. long over all, 45 ft. beam and 24 ft. deep. Her present power equipment consists of a single-screw, triple-expansion, three-crank condensing engine, 18-30-50 by 36 in. stroke. She indicates 1,050 H. P. at 90 to 95 R. P. M. The engine is of the typical box-column and jet-condensing type. She is fitted with direct-connected air pump and has independent steam-driven reciprocating, bilge, sanitary and feed pumps. The complete engine room weight, including piping and all auxiliaries, is, in round figures, 182,000 lb.

The boiler room equipment consists of two single-ended Scotch boilers 11 ft. 10 in. mean diameter each; 11 ft. length over heads, operating on a working pressure of 180 lb. per sq. in. Each boiler is fitted with two 42-in. corrugated furnaces and has 244 2¾-in. tubes. The grate surface is 36¾ sq. ft. and the heating surface 1,642 sq. ft. in each boiler.

The boilers are fitted with forced draft from a 66-in. steam-driven fan. The air for the draft is taken from the stoke hole and the fan is located in the engine room. The fan discharge passes through air heaters in the uptake and thence through ducts to the under side of the grates. The complete boiler room weight, including water in the boilers, but not fuel, is 170,000 lb. These weights are actual figures.

The coal bunker extends from the main deck to the tank top and is arranged athwartship. It has a capacity of 170 tons. The bunker doors face the stokers on the stoke hole floor. The bunker is 6 ft. fore and aft. at the stoke hole. The distance from the forward to after bulkhead in the boiler room is 24 ft. 0 in. The distance from the forward to the after bulkhead in the engine room is 22 ft. 0 in., making a total overall length for the plant, including bunkers, of 52 ft. 0 in.

The coal consumption on this vessel is from 1.8 lb. to 2 lb. per I. H. P. hr. for all purposes. This coal is of approximately 13,500 B. T. U. per lb.

Two Different Arrangements Shown.

The problem of substitution of gas for steam, aside from the design of the construction of the gas producers or cylinders of the gas engines, has been thoroughly worked out by the designers. The illustrations show two different arrangements of gas producers with the same engine. The proposed gas engine is a four-cylinder, double-acting, reversing type, having cylinders 24 in. bore by 36 in. stroke, delivering 1,000 B. H. P. at 100 R. P. M. The reversing is accomplished by means of compressed air, which is used to shift the cams from the head to the stern position. Compressed air is admitted to the cylinders by timed cams in proper cycle. The crank shaft of the engine is rigidly coupled to the tail shaft of the screw.

The illustrations show a column-framed engine. Since making this lay-

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out, the design of the engine has been modified to meet all of the present marine conditions now found in marine engine design on the lakes. In fact, with the exception of the condenser shown on the steam drawings, the gas engine frame will be very similar to the steam engine.

For the generation of current to drive the auxiliaries, there will be installed two double-cylinder, double-acting gas engines, direct-connected to 50-kw. direct-current generators. All of the pumps and auxiliaries will be motor-driven. A smaller direct-connected

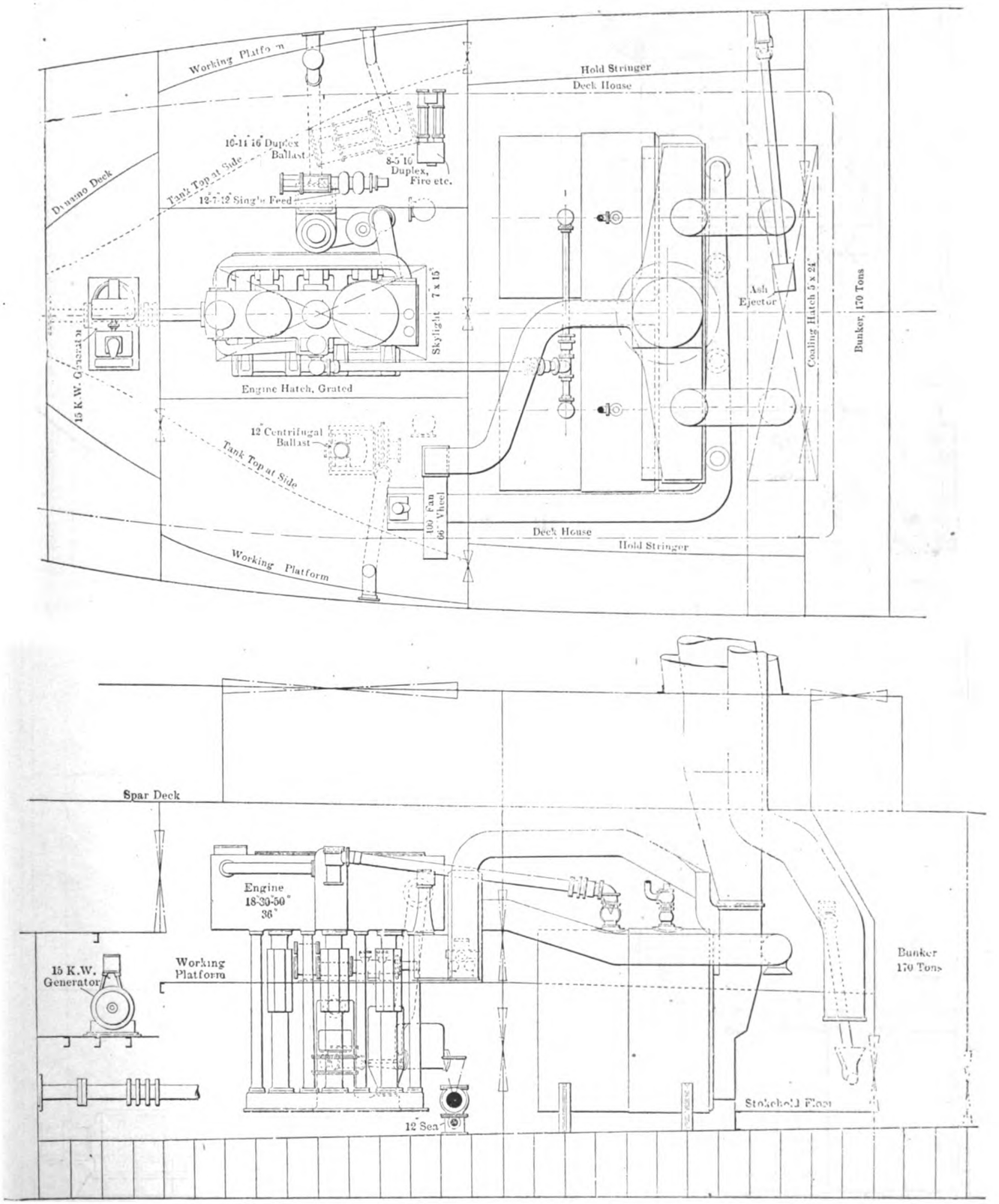

FIG. 1—PLAN AND ELEVATION OF 1,000 H. P. STEAM EQUIPMENT NOW INSTALLED IN LAKE FREIGHTER. TRIPLE-EXPANSION ENGINES; TWO SCOTCH BOILERS.

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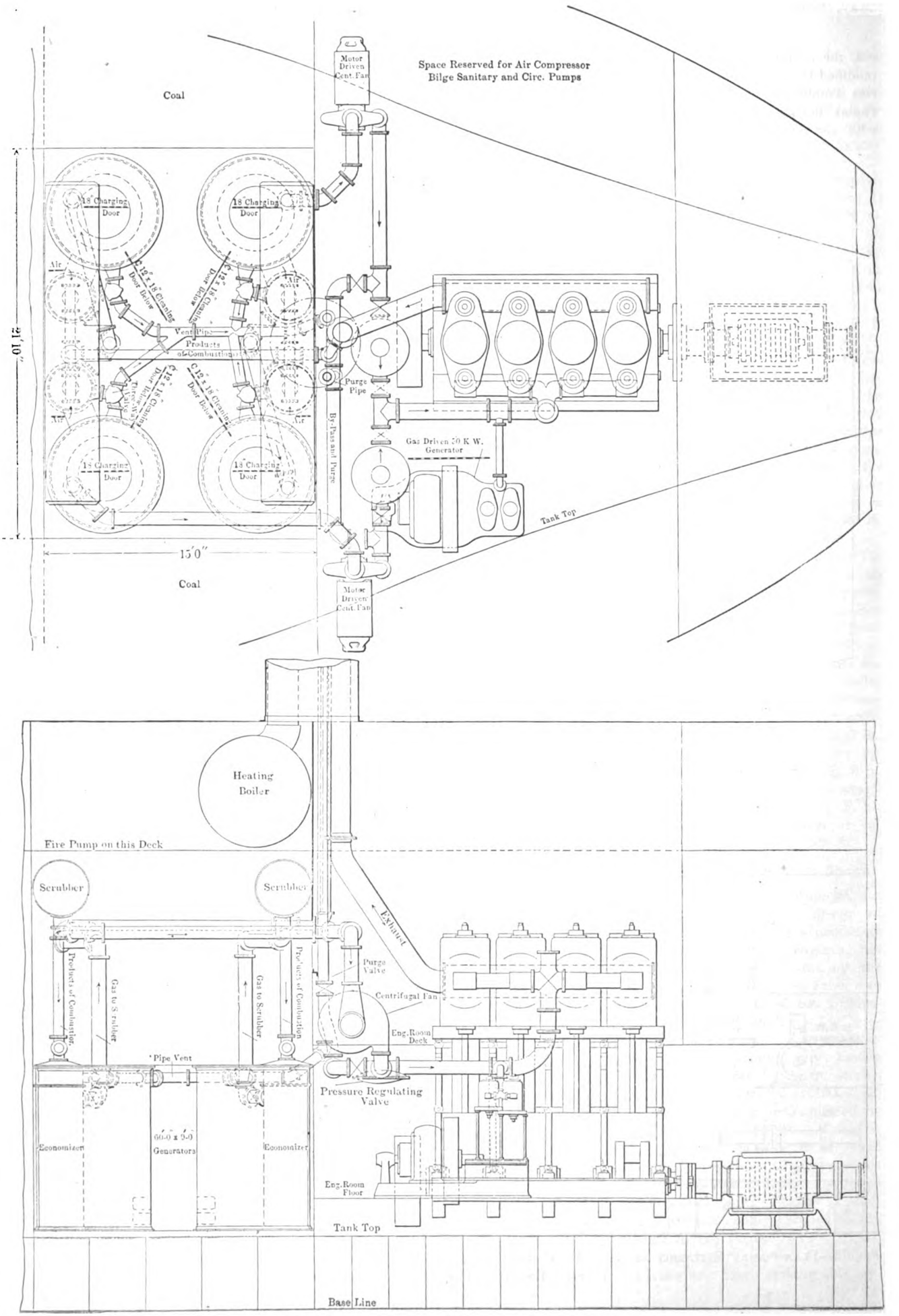

FIG. 2—PLAN AND ELEVATION OF PROPOSED FOUR-CYLINDER MARINE PRODUCER PLANT; 1,000 H. P.

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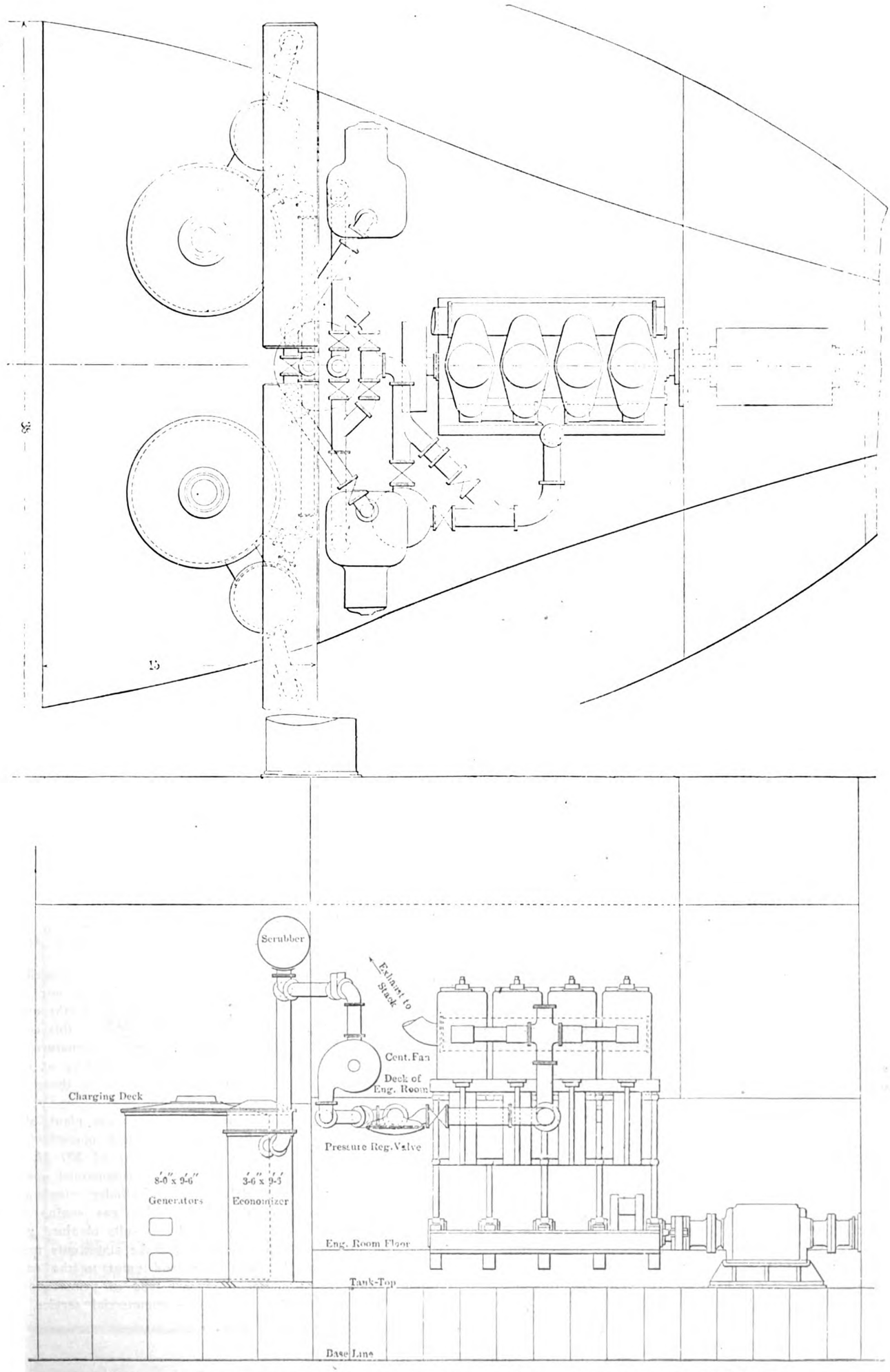

FIG. 3—PLAN AND ELEVATION OF PROPOSED TWO-GENERATOR MARINE PRODUCER PLANT; 1,000 H. P.

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unit operating on oil will be used for pumping, blowing fires, or other service, when the gas plant is down. Allowing a distance of 4 ft. 3 in. between the forward bulkhead in engine room and the forward end of the shaft, which distance is 1 ft. greater than that in the steam installation, we have an over-all distance between forward and after bulkheads in the engine room of 19 ft. 6 in.

The Four-Generator Plant.

As previously stated, two arrangements of producer room are shown. The first, the four-generator plant, consists of four 6-ft. by 9-ft. generators, each fitted with independent economizers. The forward pair and the after pair are connected independently to two horizontal gas scrubbers, which are shown slung under the main deck beams. The gas passes from these scrubbers to independent motor-driven centrifugal gas-cleaning fans, whence it is delivered, either through common connection to a purge or blow-off pipe which also acts as a by-pass, or through two gas pressure regulator valves to the air and gas mixing valve at the engine manifold. The 6-ft. generators require only one cleaning door each. As a result a single cleaning space suffices for the four machines, allowing them to be grouped with reference to athwartship space, so as to give ample room on each side of the vessel for coal bunkers. The total space occupied by the producer plant is 21 ft. 10 in. athwartship, and 15 ft. between forward and after bulkheads. The producer room weight including generators, economizers, piping and scrubbers, complete, of the four-generator set, is 110,000 lb. This weight is estimated, but has been carefully checked and completely covers all the mechanism. In addition to the above mechanism, there will be a heating boiler which is shown on the main deck. This boiler will serve to furnish low-pressure steam for heating the vessel and supplying hot water for washing down decks, etc. This boiler, with water, will weigh about 8,000 lbs.

The Two-Generator Plant.

The two-generator producer plant, which will undoubtedly be the one installed, will consist of two 8 ft. diameter by 9 ft. 6 in. generators, connected to independent air economizers and each fitted with an independent horizontal scrubber, located athwartship under the main deck beams. The gas outlet at the scrubbers will be connected with a cross-over, so that either exhauster may operate either or both producer plants. The exhausters are installed in duplicate and are connected with common purge or blow-off and common gas outlets leading either through one pressure-regulator valve, or through a by-pass direct to the air and gas mixing valves at the engine manifold.

On account of the fact that the 8-ft. generators require two cleaning doors set at 120 deg. the double-generator unit plant will require the full athwartship space in the producer room. The approximate floor space occupied, therefore, will be 30 ft. athwartship and 15 ft. between forward and after bulkheads. The producer-room weight, including generators, economizers, piping and scrubbers complete for the two-generator set, is 82,000 lbs. This weight is estimated, but has been carefully checked and completely covers all of the mechanism. As in the case of the four-generator plant, a low-pressure boiler for heating service will be installed. In the two-generator plant, however, this boiler will be located on the producer-operating floor, so that one set of firemen may suffice for both.

Probable Fuel Consumption.

The only guide we have for estimating the probable fuel consumption for this service is found in the large number of stationary producer gas power plants now in operation. Fortunately, in marine service, the load factor will be uniformly much higher than that found in any stationary service to which gas power is applied at the present time. The builders of this apparatus are prepared to guarantee one brake horsepower per hr. on *one* lb. of good bituminous coal, averaging 13,500 B. T. U. per lb.

The engineers who designed the steam plant, and who have spent years on the problem of the substitution of gas for steam, have suggested that the coal bunker, which will be placed above the charging deck of the producer, should have a capacity of about 80 tons of coal. These bunkers will run from the charging deck to the deck-house roof and will have doors opening closely adjacent to the charging doors of the generators, so that little or no coal passing on the operating deck will be required.

In making the comparison shown in the table, it is unnecessary to go into the cost of fuel, labor, hours of service, etc., as these elements vary with every class of service. In this particular proposition, it will suffice to state that the engineers who have been working on this substitution problem have conservatively figured that with the saving in fuel and the increased cargo carried, the cost of the complete plant will be saved in two years of operation.

TABLE I.
COMPARISON OF POWER PLANTS FOR GREAT LAKES FREIGHT-CARRIER.

Length over all ..... 306 ft. 0 in.
Beam ..... 45 ft. 0 in.
Depth ..... 24 ft. 0 in.
Displacement .....6,600 tons net.
Cargo.....4,200 net tons. 18 ft. draught.
Speed, 12 statute miles per hr. on 900 I. H. P.

STEAM.

Engine Room.

3-cylinder, triple-expansion, condensing, 18-30-50 by 36 in., 1,050 I. H. P. at 90 to 95 R. P. M.
Auxiliaries steam-driven.
Length between bulkheads, 22 ft. 0 in.
Engine room weights, including auxiliaries and piping, 182,000 lbs.

Boiler Room.

2 single-ended Scotch boilers fitted with economizers, forced draft. Length each boiler, overheads 11 ft. 0 in.
Mean diameter, each, 11 ft. 10 in.
Two 42-in. furnaces each.
244 2¾-in. tubes, each.
Grate surface, each, 36.75 sq. ft.
Heating surface, each, 1,642 sq. ft.
Boiler room weight, water in boilers, no fuel, 170,000 lbs.
Length boiler room 24 ft. 0 in.
Length boiler room, includes bunkers, 30 ft. 0 in.
Square feet boiler room, including bunkers, 900.
Square feet per H. P., 0.9.
Bunker capacity, 340,000 lbs.
Total weight, machinery and fuel, 692,000 lbs.
Total length of machinery space including bunkers, 52 ft. 0 in.

GAS.

Engine Room.

4-cylinder, 4-cycle, double-acting, gas engine, 24 in. diam., by 36 in. stroke.
1,000 B. H. P. at 95 R. P. M.
Auxiliaries motor-driven.
Length between bulkheads, 19 ft. 6 in.
Engine room weights, 105,000 lbs.

Producer Room.

Two down-draft gas producers and auxiliaries.
Diameter shell, each generator, 8 ft. 0 in.
Inside diameter, lining generator, 6 ft. 3 in.
Height shell, each generator, 9 ft. 6 in.
Grate surface, each generator, 30.67 sq. ft.
Producer room weights, no water, no fuel, 82,000 lbs.
Length producer room, includes bunkers, 15 ft. 0 in.
Square feet producer room, 450.
Square feet per H. P., 0.45.
Square feet producer room with four smaller generators, 330.
Square feet per H. P., four generators, 0.33.
Bunker capacity, 160,000 lbs.
Total weight, machinery and fuel, 347,000 lbs.
Total length of machinery space, 34 ft. 6 in.
Saving in weight, 355,000 lbs.
Saving in fore-and-aft length, 17 ft. 6 in.
Saving in cubic space 17 ft. 6 in. by 32 ft. beam by 20 ft. high, 11,200 cu. ft.

While the gas plant here described has neither been constructed nor ordered at this writing, its forthcoming will not be long delayed, and this comparison, while somewhat premature, is made to present the possibilities of marine producer gas power to those interested in its future.

A marine bituminous gas plant, similar in construction and operation to the one described, but of 300 H. P. capacity, has been in commercial operation driving a six-cylinder, single-acting, reversing marine gas engine for over a year. The results obtained give ample security for the statements made in this paper, and point to the early adoption of this type of prime mover for our marine commercial service.

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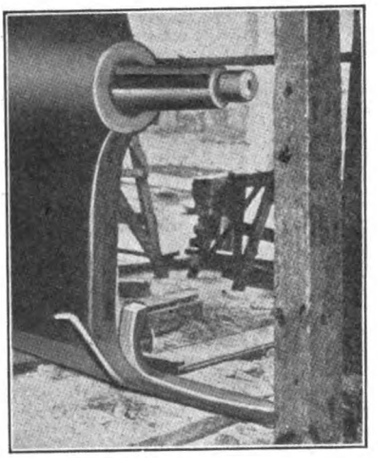

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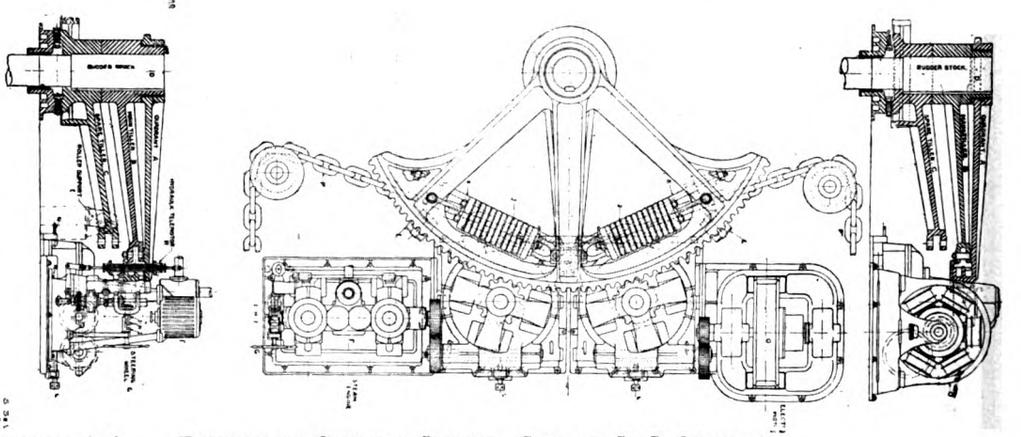
WILLIAMSON BROTHERS ELECTRICALLY-OPERATED STEERING GEAR.

We illustrate herewith a type of electrically-operated steering gear, which has been in successful use for several years. Briefly, the construction is as follows: On the rudder stock are mounted two quadrants, one keyed and the other loose, the connection between the two being made by a pair of heavy spiral springs for the purpose of absorbing shocks. A gear pinion on a vertical shaft engages with the loose quadrant and the vertical shaft referred to also carries a worm wheel driven by a worm on the motor shaft. Current is supplied by an independent motor generator. The pilot house column is similar in appearance to the ordinary steering column, and contains a set of variable resistances controlled by a movable contact arm moved by the steering wheel. A similar set of resistances is located at the after end of the ship with its contact points controlled by the variable position of the rudder. The movement of the wheel in the pilot house disturbs the equilibrium of resistance, causing a flow of current which operates the motor. The movement of the rudder tends to restore this equilibrium and stop the motor, thus making it necessary to continue the hand wheel movement in order to obtain a continuous rudder movement, and in the hard-over position this equilibrium is again restored in such a manner that further movement is impossible, except in the opposite direction. The early installations provided for operation by steam in case of failure of the electric gear, but this has proved to be needless and the illustration shows the gear so arranged.

The gear is built by Williamson Bros., Philadelphia, and is installed on the steamship Minnesota of the Great Northern Railway's Trans-Pacific line, and has been in continuous use since 1893.



ELECTRICALLY-OPERATED STEERING GEAR OF S. S. MINNESOTA.

RUBBERTEX CLOTH.

The Rubbertex Cloth & Paper Co., manufacturers of the "Rubbertex Line" of waterproof cloth, belting, packing, roofing, and waterproof paints, are erecting a new plant at Clearing, southwest of Chicago, near Argo, where the Corn Products Refining Co.'s new plant is located.

The various lines manufactured by the Rubbertex Cloth & Paper Co. are all based on their method of saturating cloth. It is claimed that the treatment that is given the cloth renders it not only absolutely waterproof but acid and oil-proof; and more than this, that it is absolutely protected against rot, as the ingredients of the treating compound are such that they preserve the fabric and absolutely prevent disintegration.

Cotton duck is the material treated and this in various weights is made up into tarpaulins, hatch covers, roofing, belting and sheet packing. The company also has a considerable trade in bagging for the manufacture of cement, lime and fertilizer bags and packages for perishable products where exposure to the elements is to be avoided. Not only do the company claim the waterproof and other qualities above enumerated, but they also make the assertion that their cloth is unaffected by atmospheric conditions and that it will not harden and crack in cold weather.

The company's main office is in the Commercial National Bank building, Chicago. Branch offices are maintained in New York city and Detroit, as well as numerous agencies in all of the larger cities in the country.

LAKE LAUNCHINGS.

The bulk freighter Shenango was launched from the Ecorse yard of the Great Lakes Engineering Works on Saturday last for the Shenango Steamship Co., in which Mr. W. P. Snyder is the leading spirit, and was christened by Miss Sarah C. Chaplin, of Sewickley, Pa. Mr. Snyder attended the launching with a party of friends from Pittsburg, arriving on a special train. The Shenango, which will be brought out by Capt. Henry Peterson, is 605 ft. 5 in. over all, 580 ft. keel, 58 ft. beam and 32 ft. deep. She has 35 hatches spaced 12-ft. centers. Her engines are triple-expansion with cylinders 24, 38 and 65 in. diameters by 42-in. stroke, fitted with Scotch boiler, 16 ft. by 12 ft., equipped with forced draft, and allowed 180 lbs. pressure. Her carrying capacity is 12,000 gross tons. The Shenango will be equipped with the Akers emergency steam steerer. The Akers transmission will also be used on the Shenango for the regular steering gear.

The bulk freighter John J. Barlum, building for the Postal Steamship Co., of Detroit, was launched from the Lorain yard of the American Ship Building Co., on April 20, and was christened by Miss Veola N. Barlum. The steamer is 524 ft. over all, 504 ft. keel, 54 ft. beam and 30 ft. deep, having 30 hatches spaced 12 ft. centers. Her engines are triple-expansion with cylinders 23½, 38 and 63 in. diameters by 42 in. stroke, supplied with steam from two Scoth boilers, 14 ft. 6 in. by 11 ft. 6 in., equipped with Ellis & Eaves draft and allowed 180 lbs. pressure. She will be sailed by Capt. Murray G. McIntosh. Her auxiliary equipment includes an Akers emergency steam steerer.

The steamer Benjamin Noble was launched from the Wyandotte yard of the American Ship Building Co. on April 28, and was christened by Miss Olive Elaine Noble of Detroit in honor of her father. The Noble is of Canadian canal size and will be operated by the Capital Transportation Co. of Detroit in the pulp wood trade.

The lake survey steamer Engineer was launched from the yard of the Manitowoc Dry Dock Co., Manitowoc, Wis., on April 12.

DETROIT RIVER STEAMERS.

The name, "Detroit, Belle Isle & Windsor Ferry Co.," and the steamers operated under it have long been familiar about the great lakes and fairly indicate the original scope of the business. That has long since been outgrown, and is now dwarfed by the enormous excursion traffic which the company has built up and the really splendid steamers it has built to care for it. Its field of operations now extends from Lake Huron to Lake Erie, and the name, "Detroit River Steamers," which will appear hereafter in all the company's announcements in the form shown above is, therefore, not only more convenient but much more appropriate, though the corporate name is not changed.

It may be added that the steamer shown above the escutcheon is a reproduction of the cut which has long been familiar in the company's announcements.

Bids opened by Lieut. Col. W. L. Fisk, United States engineer at Buffalo, for the completion of the extension arm of the Stoney Point breakwater were as follows: MacArthur Bros. Co., New York, $89,461.75; Great Lakes Construction Co., Buffalo, $69,907.00; James Dunfee, Syracuse, $55,884.25; The Breakwater Co., Cleveland, $51,298.75.

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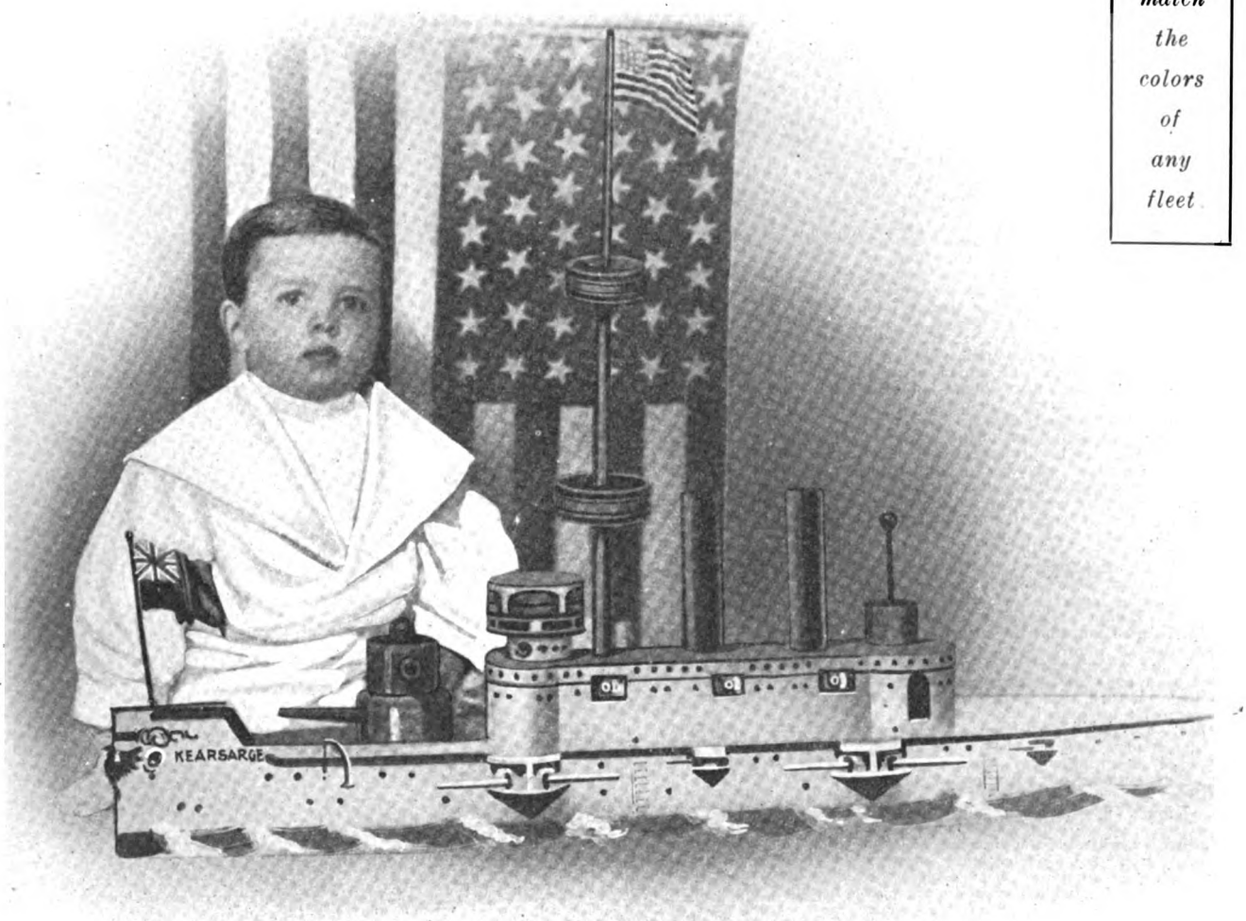

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ENGINEERS AND LAKE VESSELS.

Apathy continues to mark the lake trade so that the strike declared against the open shop policy of the Lake Carriers' Association by the Seamen's Union and the difficulties with the Marine Engineers' Beneficial Association have not had a marked effect. The Lake Carriers' Association adopted the open shop policy a year ago and do not intend to depart from it hereafter. The members of the association endeavored to enter into individual contracts with the engineers, paying the same wages as last year, but the officers of the Marine Engineers' Beneficial Association instructed the men not to sign individual contracts, but advised them to take their positions without signing contracts if possible. It is known that a large portion of the engineers wished that their association might waive this technical objection in such a lame year as this as they were anxious to be at work. The Lake Carriers' Association declared that the union policy aboard ship during the past five years had not worked and are firm in their refusal to return to it. Both masters and engineers admit the difficulties that they have experienced with union firemen and deck hands. The first break in the ranks of the Lake Carriers' Association occurred on April 12, when the Anchor Line and Western Transit Line, both package freight companies, made arrangements with their engineers without contracts. Both lines were promptly suspended from membership in the Lake Carriers' Association, the association declaring that it would prefer to be a small, compact body than a larger one with divided interests.

The first bulk freighter to leave was the Charles A. Weston, which sailed from Buffalo with a non-union crew. She was followed by the D. R. Hanna of the Hutchinson fleet.

The Pittsburg Steamship Co. had definitely announced that it would open navigation as soon as the ice permitted. The steamer John W. Gates was put into commission on April 17 and the company has been steadily since putting vessels into commission until now it has a fleet of about sixty vessels moving. A few desertions occurred, but their places were at once filled. Some violence has been displayed, but nothing of a serious character. The earlier vessels that arrived at lower lake ports found a cordon of police on the docks to see that no disturbance occurred. Vessel owners manifest little interest in the strike. In fact, the independent interests probably welcome anything that delays the early movement of freight, as there is not enough business offering to keep the whole fleet in employment.

As persistent rumors were abroad that the Pittsburg Steamship Co. intended to reduce the number of its men, President Coulby wired the following instructors to all agents of the company:

"There seems to be a persistent rumor inspired by agitators that it is my intention to eventually reduce the number of the crew on our ships. I have no such intention, and while it may be necessary, on account of your being unable to get competent men, to go short handed a trip or two, the pay for whatever man you are short is to be divided amongst the men who do his work."

LAKE VESSEL LOSSES.

April was marked by accidents of an extraordinary character on the lakes. A succession of wind storms of unusual violence occurred, packing the ice tightly in Whitefish Bay and imprisoning a number of steamers. The steamer Aurania, belonging to John Corrigan, grounded at Point Iroquois and when released later was caught in the ice. Whether she was injured in grounding is not known, but the crew noted that she began to settle at the bow in the ice, finally taking a list that made it almost impossible for the crew to stand on the decks. The ice was a mass of broken bergs and cakes which had been driven together and piled up by the wind. On one side of her were three miles of ice of this character and on the other side one mile of it pressed against her sides by the wind. Seeing that the ship was doomed the crew put the three boats overboard and climbed onto the floes, managing to drag the boats a sufficient distance from the ship. The ice continued to press until her masts touched the water when she sank slowly and slipped beneath the waters. The crew of twenty men were three miles from shore on floating ice. The crew first attempted to pull the boats over the ice, but finally abandoned the two heavy yawls, retaining only the light boat in which they crossed open stretches of water. It is extraordinary that every member of the crew managed to reach the steamer Bartow safely, though several of them went through the ice time and again.

Capt. White of the Bartow had been watching the struggle and had a yawl ready to go to their assistance should the floes part. In this connection Capt. Robert C. Pringle of the Aurania charges that one Canadian boat and two steamers of the Peavey Line disregarded his signals of distress.

The Aurania was a steel vessel and was built by the Chicago Ship Building Co. in 1895. She was originally a barge but was transformed into a steamer a few years ago. She was 352 ft. keel, 44 ft. beam and 26 ft. deep. She carried a cargo of coal and was fully insured.

Equally extraordinary was the wreck of the old steamer Eber Ward which sank in the Straits of Mackinac on April 20, drowning five members of her crew. It is maintained by the crew that she sank as the result of a collision with a heavy ice floe, though it is probably the first instance on record of a lake steamer having been sunk in a collision of that sort. The accident occurred in the early morning and the five that were drowned were asleep in their bunks. The nine survivors barely had time to lower the yawl boat before the vessel disappeared, her bow having been completely shattered and the steamer quickly flooded.

A. P. Gallino of St. Clair, first mate, says that when the collision occurred he hurried to a manhole near the bow with the intention of descending by means of a small iron ladder that had always been there. Finding the ladder gone he pushed his foot and then his hand through the opening and maintains that he encountered a great mass of ice in the bow of the craft. The steamer was under good headway at the time.

The Eber Ward was of oak and was built by F. W. Wheeler & Co., West Bay City, Mich., in 1888. She was 213 ft. keel, 37 ft. beam and 23 ft. deep.

The steamer Russia, an iron ship which for a number of years operated in the package freight trade between Buffalo and Lake Michigan ports, foundered near Detour, but her crew succeeded in reaching the shore safely. The Russia was built by the King Iron Works in Buffalo in 1872 and had latterly been operated by the Port Huron & Duluth Steamship Co. She was bound for Duluth on her first trip of the season with a full cargo of freight. Twelve miles off Detour the cargo shifted. The crew began jettisoning the deck load of cement when the cargo again shifted and the steamer began to fill. The Russia was 231 ft. keel, 35 ft. 6 in. beam and 25 ft. deep.

The schooner George Nester foundered on Lake Superior with all hands. She carried a crew of seven men, Capt. George DuBeau of Algonac being master. The Nester was in tow of the schooner Schoolcraft. They were caught in the blow while off Huron Island. The tow line parted and the schooner was dashed to pieces on the rocks. The furious waves made it impossible to launch small boats from either the Schoolcraft or the lighthouse tender Marigold which was close behind, and the crew of seven were drowned.

The Nester was built in 1887 and was 216 ft. keel, 35 ft. beam and 14 ft. deep.

ORE ON DOCK MAY 1.

Statistics gathered from the various dock managers at Lake Erie ports show that the amount of ore on Lake Erie docks May 1 of the present year was 5,370,268 gross tons, as against 5,480,300 tons in 1908, a decrease of 110,032 tons.

The total rail shipments from Lake Erie ports to furnaces during the winter season (Dec. 1 to May 1) aggregated 3,071,265 tons, viz:

On dock Lake Erie ports, Dec. 1, 1908	8,441,533
On dock May 1, 1909	5,370,268
By rail to furnaces, winter of 1908-9	3,071,265

Adding these winter shipments of 17,453,258 tons, the amount shipped to furnaces during the navigation season of 1908, gives 20,524,523 tons as the entire consumption of ore from Lake Erie ports during the year ended May 1, 1909, as against 31,692,446 tons for the year ended May 1, 1908, as against 30,099,769 tons for the year ended May 1, 1907, as against 28,984,358 tons for the year ended May 1, 1906, as against 20,057,070 for the year ended May 1, 1905, 18,739,995 tons for the year ended May 1, 1904, 21,905,251 tons for the year ended May 1, 1903, 17,216,065 tons for the year ended May 1, 1902, 14,465,260 tons for the year ended May 1, 1901, 15,882,881 tons for the year ended May 1, 1900, 12,122,982 tons for the year ended May 1, 1899, and 10,209,488 tons for the year ended May 1, 1898.

The following table gives the amount of ore on dock at the close of navigation last year and the opening this year:

Ports.	May 1, 1909.	Dec. 1, 1908.
Toledo	380,675	590,925
Sandusky	31,528	36,079
Huron	379,364	458,158
Lorain	362,096	426,274
Cleveland	1,018,055	1,458,392
Fairport	562,679	835,821
Ashtabula	1,392,430	2,293,531
Conneaut	497,203	1,296,675
Erie	557,029	730,530
Buffalo	189,209	315,148
Total	5,370,268	8,441,533

The Scully Steel & Iron Co., Chicago, have recently opened large new warehouses at Jersey City, N. J., where they will hereafter carry a full stock of boiler makers' and iron workers' supplies, particularly boiler braces, boiler flanges, pressed steel boiler lugs, pressed steel crabs, staybolts, patch-bolts, staybolt taps, patch-bolt taps, Everlasting blow-off valves, tube expanders of all kinds, flue cutters, flue cleaners, hose couplings and small tool supplies of every kind. This new departure on the part of the Scully Steel & Iron Co. is in response to a continued demand from eastern boiler and structural shops for an eastern stock. With the new equipment, the Scully Steel & Iron Co. will now be able to supply this eastern trade, making immediate shipment from stock at Jersey City. This eastern warehouse will be a branch of the large warehouses at Chicago, where the Scully company carry the largest stock of boiler and iron workers' supplies in the world, and the stock at Jersey City will be continually replenished from the Chicago warehouses. The Scully Blue Book showing the complete line carried, will be sent on request.

U. S. Engineer Office, Duluth, Minn., May 8, 1909. Sealed proposals for furnishing riprap at Ashland, Wis., will be received here until noon, June 8, 1909, and then publicly opened. Information on application. Graham D. Fitch, Lt. Col. Engrs.

U. S. Engineer Office, Duluth, Minn., May 7, 1909. Sealed proposals for furnishing stone and pebbles for Superior Entry, Wis., will be received here until noon, June 7, 1909, and then publicly opened. Information on application. Graham D. Fitch, Lt. Col. Engrs.

PROPOSALS.—Sale of U. S. S. *Zafiro.*—Sealed proposals will be received at the Navy Department until noon on the 9th day of June, 1909, at which time and place they will be opened, for the purchase of the U. S. S. *Zafiro;* appraised value, $5,000. The vessel will be sold for cash to the person or persons or the corporation or corporations offering the highest price therefor. *Proposals must be submitted in a sealed envelope addressed to the Secretary of the Navy, Washington, D. C., endorsed "Proposals for the purchase of the U. S. S. Zafiro," and each proposal must be accompanied by a satisfactory certified check for not less than 10 per cent of the amount of the offer.* On application to the Navy Department forms of bids and bonds, together with the terms and conditions of sale, also a printed list giving general information concerning the vessel, will be furnished. The vessel can be examined at any time after the date hereof by applying to the Commandant of the Navy Yard, Puget Sound, Wash. It must be removed from the limits of the navy yard within such reasonable time as may be fixed by the Department. The *Zafiro* is not entitled to American registry. The Department reserves the right to withdraw the vessel from sale and to reject any or all bids. G. v. L. MEYER, *Secretary of the Navy.* 5-1-09

U. S. Engineer Office, Milwaukee, Wis., April 28, 1909. Sealed proposals for dredging at Manitowoc harbor, Wis., will be received here until 3 p. m., May 18, 1909, and then publicly opened. Information on application. Chas. S. Bromwell, Major, Engrs.

SEALED PROPOSALS will be received at the office of the Light-House Engineer, Buffalo, N. Y. until 11 o'clock A. M., May 28, 1909, and then opened, for constructing a light-house and an iron beacon at the entrance to Cleveland Harbor, Ohio.

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